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From

WILLIAM R. SESSIONS,

Sec. Massachusetts Board of Agriculture,

COMMONWEALTH BUILDING,

BOSTON.

transp.

THIRTY-SECOND ANNUAL REPORT

OF THE

SECRETARY

OF THE

Massachusetts Board of Agriculture,

WITH

RETURNS OF THE FINANCES OF THE
AGRICULTURAL SOCIETIES,

FOR

1884.

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STATE BOARD OF AGRICULTURE, 1885.

Members ex officiis.

His Excellency GEORGE D. ROBINSON.
His Honor OLIVER AMES.
Hon. HENRY B. PEIRCE, *Secretary of the Commonwealth.*
CHARLES A. GOESSMANN, *State Agricultural Chemist.*
JAMES C. GREENOUGH, *President Massachusetts Agricultural College.*

Appointed by the Governor and Council.

	Term expires.
JAMES S. GRINNELL of Greenfield,	1887
JAMES R. NICHOLS of Haverhill,	1888
MARSHALL P. WILDER of Boston,	1886

Chosen by the County Societies.

Amesbury and Salisbury,	J. H. HILL of Amesbury,	1888
Barnstable,	NATHAN EDSON of Barnstable,	1886
Berkshire,	HARVEY M. OWEN of Lanesborough,	1888
Blackstone Valley,	GEORGE W. HOBBS of Uxbridge,	1888
Bristol,	AVERY P. SLADE of Somerset,	1887
Deerfield Valley,	ARTHUR A. SMITH of Coleraine,	1887
Essex,	BENJAMIN P. WARE of Marblehead,	1887
Franklin,	JONATHAN BUDDINGTON of Leyden,	1886
Hampden,	ETHAN BROOKS of West Springfield,	1888
Hampden East,	WILLIAM R. SESSIONS of Hampden,	1888
Hampshire,	W. L. WARNER of Sunderland,	1886
Hampshire, Franklin & Hampden,	JONATHAN D. PORTER of Hatfield,	1888
Highland,	W. S. BOWEN of Peru,	1887
Hingham,	EDMUND HERSEY of Hingham,	1888
Hoosac Valley,	DANIEL UPTON of Adams,	1888
Housatonic,	MERRITT I. WHEELER of Great Barrington,	1888
Hillside,	ALVAN BARRUS of Goshen,	1887
Marshfield,	DANIEL E. DAMON of Plymouth,	1888
Martha's Vineyard,	EVERETT A. DAVIS of Tisbury,	1886
Massachusetts,	E. F. BOWDITCH of Framingham,	1888
Massachusetts Horticultural,	E. W. WOOD of Newton,	1888
Middlesex,	JOHN B. MOORE of Concord,	1888
Middlesex North,	A. C VARNUM of Lowell,	1886
Middlesex South,	S. B. BIRD of Framingham,	1887
Nantucket,	R. E. BURGESS of Nantucket,	1888
Plymouth,	JOHN LANE of East Bridgewater,	1887
Union,	LEWIS C. NYE of Blandford,	1886
Worcester,	C. L. HARTSHORN of Worcester,	1887
Worcester North,	EDWIN A. GOODRICH of Fitchburg,	1887
Worcester North-West,	J. P. LYNDE of Athol,	1886
Worcester South,	JOHN O McKINSTRY of Southbridge,	1886
Worcester West,	J. HENRY GODDARD of Barre.	1887

JOHN E. RUSSELL,
Secretary.

THE
THIRTY-SECOND ANNUAL REPORT
OF THE
SECRETARY
OF THE
BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The year has not been remarkable for the prosperity of farming, nor has it been marked by any special calamity. Our population engaged in agriculture has been well supported. There has been no sign of suffering, discontent or anxiety noted at our public gatherings; no strikes among our laborers, nor murmurs of complaint from them in regard to hours of labor or amount of wages.

Farmers have not grown richer, but they have held their own, and probably increased the productive capacity of their land, with the exception of their pastures.

We had our usual experience of summer drouth over the greater part of the Commonwealth; in several counties the grass, our chief crop, was much injured, and it was below the average in all the counties. All garden crops were heavy; potatoes gave a good yield of excellent quality; fruit was abundant, and the apple harvest was remarkable;

the demand for export to England has been steady and has kept up a remunerative price. The total export from all ports to March 1st amounted to 747,000 barrels, which has given to the farmers more than a million dollars. This great sum has been chiefly paid to New England.

The total export of apples from American ports for six successive years has been : —

1879–80,	435,800	barrels.
1880–81,	1,330,800	"
1881–82,	239,000	"
1882–83,	400,000	"
1883–84,	60,714	"
1884–85,	747,000	"

The return to the orchardist from these exports must have been more than eight million dollars. The demand for our apples abroad is increasing, and however large our crops may be in future, we can safely count upon remunerative prices.

The production of milk to supply our large towns and cities is a branch of husbandry that in late years has not been satisfactory ; the farmers have allowed shrewd contractors to control the supply and sale of milk, and have accepted prices lower than the cost of the product.

This year co-operation of the farmers in refusing to deliver milk at the former low rates, and a rigorous inspection of the milk sold in the cities, which has prevented its extension by water, has made the present year prosperous to this important industry.

Milk producers are heavy buyers of grain, and the enormous crops and consequent low prices at the West have been greatly to our advantage.

It is to be hoped that the lessons that our herdsmen have been compelled to learn in the school of adversity will not be forgotten in prosperity. They have learned that they can control their market when they unite for that purpose, and that they have the support of the community against the rapacity of the middlemen.

It is clearly proved that a faithful inspection of milk and a strict enforcement of the laws punishing adulteration is to the great advantage both of the producer and the consumer. This inspection not only prevents dishonest dealers from increasing the supply by adding water, but it also gives confidence to consumers, and induces increased use of milk as an article of food. Milk diluted with water, or skimmed and treated with boracic acid and caramel is unfit for the food of robust adults, and is poisonous to infants. Not unfrequently the water used to extend good milk is taken from wells or streams polluted by drainage. This fraudulent tampering with the public health was carried on with the most impudent boldness and impunity until the inspection of milk and the prompt punishment of violation of the law has wrought a complete reform; and now, milk quite up to the high standard required by our laws can be relied upon by the purchasers.

It cannot be denied that among those detected in the adulteration of milk there have been some farmers; but the greater part of the milk received from the farms is above the requirements of the Massachusetts standard, and has been handled with scrupulous cleanliness. Such milk is relatively the cheapest form of food.

Few city families are aware of the value of milk in diet; they use it for the most part to impart color to tea and coffee, or, when compelled by necessity, to nourish infants.

The public has for years known the facility with which milk could be adulterated and has suspected its purity, using as little of it as possible. The suspicion has restricted the use of milk in cooking, while it is almost unrecognized as a beverage.

Confidence will in time be established, under faithful public inspection, and the people learn the value of good milk as a daily food, thereby largely increasing the demand for it.

Dairying in all branches has been fairly prosperous. The use of substitutes for butter made from various fats and oils has not prevented a good demand for superior butter at fair prices.

The report of the cattle commission, which will be found in its place, was presented to the legislature in January. It mentions the disease of "cholera" as threatening our swine, but the commissioners were then hopeful that there would be no considerable spread of the trouble. Since the publication of their report there has been an alarming increase of the disease, and the old Massachusetts Society for the Promotion of Agriculture, with characteristic liberality, proceeded to investigate the matter. Competent men were employed in all the counties to report to the society, and it was soon made clear that we had in several districts an acute, contagious fever, similar to the disease existing in Missouri, Illinois and Indiana. This disease of "cholera," or "swine plague," has been prevalent at the West for several years. Dr. Salmon, chief of the United States Bureau of Animal Industry, estimates the loss from its ravages in 1884 at over fifty millions of dollars. It has been brought into this Commonwealth by the importation of hogs from the West, and it is liable to occur wherever hogs are fed upon swill into which infected particles from diseased swine have been cast, or wherever imported hogs are brought. The germ must be present to cause the sickness, and hogs isolated and carefully fed will not have it. The symptoms, as described by Dr. Salmon, are increased temperature, loss of appetite, redness of the skin, sometimes accompanied by cough and diarrhœa. Post-mortem examination reveals the lungs congested and inflamed, the large bowels ulcerated, and the abdominal cavity and pericardium partly filled with a clear or slightly yellow liquid. Medical treatment to the present time has not been effectual in curing the sick animals. A wide range of remedies, vegetable and mineral, have been tried, and intelligent men, stimulated by the importance of the matter, are daily at work upon the problem. Advertised specifics are not wanting, but on examination or trial they prove to be worthless.

The annual fairs of the societies connected with the Board of Agriculture were unusually successful; the attendance at several of them surpassed all previous record, and the exhibitions of fruit, flowers and vegetables were remarkable.

The financial statements of the societies will be found in the usual place, and show improvement over previous years.

The institutes ordered by the Board have been duly held, and have been of great advantage to the people attending them. They occasion much expense in travel, and draw heavily upon the time of the members of the Board and the Secretary. In those districts where the institutes are appreciated they will be held as they have been in the past; but in future the matter will be left with the officers of the societies to do as they think best.

JOHN E. RUSSELL,
Secretary.

PUBLIC MEETING OF THE BOARD

AT

GREAT BARRINGTON.

PUBLIC MEETING OF THE BOARD AT GREAT BARRINGTON.

The country meeting of the Board for the year 1884, was held at the Town Hall, in Great Barrington, commencing on Tuesday, December 2d, and continuing until noon of the 4th. The meetings were not as well attended as they should have been by the farmers of the western part of the State. A number of the prominent agriculturists of Connecticut were present, some of whom participated in the proceedings.

The meeting was called to order at 10.30 by Mr. Merritt I. Wheeler of Great Barrington, member of the Board from the Housatonic Society, who delivered the following address.

MR. WHEELER'S ADDRESS.

It is my privilege, as an acquaintance of both, to introduce to the members of the Housatonic Agricultural Society and to the citizens of southern Berkshire the Massachusetts State Board of Agriculture. To facilitate the acquaintance, I may be permitted to say a few words descriptive of each of the parties who meet to-day for the first time. Of the Board of Agriculture it is necessary to say but very little. That organization is known and read of all men who are interested in the agriculture of Massachusetts. For more than thirty years the record of its proceedings as detailed in the Secretary's report, has been published and scattered among the agricultural community of the Commonwealth, and sought after and read with the greatest interest.

I think the first meeting of this kind held by the Board was at Springfield in 1864, twenty years ago this present month, and these meetings have been held annually ever since in different parts of the State, coming to-day for the first time to southern Berkshire. The influence of these gatherings can hardly be estimated, addressed as they have been by the best-informed minds in the country, on subjects of the greatest interest to the community, stimulating a spirit of investigation, imparting information and making the knowledge and experience of each participant the common possession of all. Valuable results must have been attained. And, gentlemen of the Housatonic Agricultural Society, if you do your part in discussing and elucidating the subjects to be presented at this meeting, it will add another page to the record of success that marks the history of the State Board of Agriculture.

To the gentlemen of the Board I think I will be justified in a more extended description and history of this locality.

You who live in eastern Massachusetts *may* have heard of the Housatonic Valley. You are quite certain to have heard of Berkshire County and of the Berkshire Hills, but you have seldom met a citizen of southern Berkshire.

By reason of the topographical features of this valley, this section of the State belongs essentially to New York. Our social and commercial, and, in fact, all our relations, except political, are more with New York than with Massachusetts. If the avenues of travel were such as to make Boston as accessible as New York, the feeling of State pride would do much to change the course of business, and indirectly increase our interest in whatever pertains to the prosperity of the Commonwealth.

In coming here, and returning to your homes, you will have experienced the disadvantages under which we live in this particular, and I expect, as one result of your visit here, that you will individually, as opportunity may offer, favor any reasonable scheme for giving us easier and more direct communication with the rest of the State. I wish to say, however, on this subject, that our railroad facilities are all that can be asked from a single line. The Housatonic Railroad carries us over its line at frequent intervals, with reasonable speed and with a great degree of safety and comfort, and is eminently a good road as far as it goes, but it doesn't go in the direction we would sometimes like to travel.

This town was incorporated in 1761, having previous to that time been included in Sheffield, and was known as the north parish of Sheffield. At the time of its incorporation it contained about 500 inhabitants, and for the next eight or ten years the history of this town is the history of most other inland New England towns of that period. Soon after 1770, however, the political condition of the country began to claim the attention of the people, and the feeling of dissatisfaction with the measures of the government — so general throughout the province — seemed to have been even more intense in Berkshire than elsewhere; and from that time on, until the close of the Revolutionary war, the history of Great Barrington is rich in its records of the zeal, energy and patriotism of its people. I shall call your attention, specially, to the history of this town during the Revolutionary period, because I think there are some events connected with that period that have never been duly recognized.

It is not generally known that the first actual, forcible opposition to British rule, the first act by which the authority of Great Britian was defied and the officers of the Crown forcibly and effectually resisted, occurred in this town and very near this place; but such I believe is the fact. It is hard to understand, at this late date, how an inland community, as remote from the seaboard as this, sparsely settled, lacking the means of intercommunication to an extent hardly to be imagined to-day, should have been so alive to the political issues of the time, and should have been actually in advance of the other portions of the Province in opposing the measures of the government, but such is the fact in regard to Berkshire. On the sixth day of July, 1774, a convention of delegates from the several towns in the county was called at Stockbridge, to take into consideration certain acts of Parliament, affecting the interests of the colonies. At that convention resolutions were adopted setting forth principles at variance with the policy of the government, but at the same time acknowledging allegiance to the king. A committee was also appointed to frame articles of agreement to be recommended to the towns in the county, to prevent the use of articles of British manufacture. That committee reported and the convention adopted a covenant providing for various measures of political interest in conformity with the sentiment of the people, and, incidentally, one of agricultural interest; viz., "For the care and preservation of sheep and for the raising of flax and for the manufacture of linen and such other cloths as shall be most useful and necessary;" thus early associating the agricultural interests with the welfare of the State.

This action of the citizens of Berkshire was probably the first *combined* action against royal rule. But even this did not contemplate forcible resistance to the constituted authorities. That step was reserved for Great Barrington, then the shire town of the county. On the sixteenth day of August, 1774, the judges of the king's court, with the attendant officers, came here to hold a regular session of the court, but were met by the people, who with force and arms prevented their sitting and repudiated their authority. I quote from Taylor's history of Great Barrington: —

> "When the time for holding this court arrived a very large body of men from all parts of the county, including from three to five hundred from Litchfield County, assembled at Great Barrington, took possession of the court house, filling it to overflowing and effectually prevented the judges and magistrate from either occupying the building or transacting any business. In vain the sheriff endeavored to make a passage for the judges. The people knew no court, recognized in the judges no authority, but insisted that they should leave the town, which they did."

And from that 16th day of August, the people of Great Barrington recognized no authority save that of the people themselves.

It may seem a very simple and insignificant matter, as an historical fact, that a crowd of men, representing, as it were, a mob, should prevent the sitting of a county court. But remember, that this was the deliberate act of the people; that they knew then, as we know to-day, that the civil authorities in the exercise of their proper functions represent the full power of the government; and in that act the people of Great Barrington commenced the actual work of the Revolution.

I quote further:

> "The patriotism of Berkshire did not exhaust itself in holding conventions, passing resolutions and suppressing the king's courts . . . The battle of Lexington was fought on the 19th of April, 1775. . . . Berkshire history avers that news of the Lexington battle arrived in this county about noon on the 20th and that next morning at sunrise the regiment of Col. Pattison were on their way, completely equipped in arms and mostly in uniform Doubts have been expressed as to the reception of the news of this *battle* on the 20th and some have thought it impossible. But the pay roll of Captain William King's company of Great Barrington minute men show that they marched on the 21st."

The great marvel in connection with the history of that period, is *how* a community in the conditions existing at that time, when the telegraph was undreamed of, when railroads were unknown, when the stage-coach had not made its appearance, and before the postal service had been established, without newspapers to discuss questions of public policy, with all these disadvantages, the people could have been educated to think and act with any degree of unanimity. A comparison of results accomplished then, and now, under existing conditions, leaves us little reason to boast of our own achievements.

Intense and bitter as the feelings of the people were, immediately before and during the war, towards those who opposed the patriot cause, no sooner was the conflict ended than they showed in various ways that kindness and humanity were characteristic virtues, notably exemplifying this in their treatment of the officers and soldiers of Burgoyne's army, who were quartered for a time in this village, while being taken as prisoners of war to Boston.

And I may as well say in this connection, that the patriotism displayed by the people of Great Barrington, in establishing the government, was equally prominent in defending it, eighty-six years later. At the breaking out of the rebellion in 1861, the population of the town was 3,871. Out of this total population the town furnished 430 men for the war, a surplus of eight over all demands of the government. The amount of money furnished by the town and by private subscription, I am unable to give, but at the close of 1864, the town had expended nearly $33,000 for war purposes and the entire indebtedness of the town was liquidated within two years thereafter.

At no period in the history of the town has there been any special impetus given to its manufacturing interests or productive industries; consequently its increase in population has been very slow, although remarkably uniform, the census of 1880 showing a total of 4,658. The manufacturing interests of the town are comparatively small, although considerable is done at Housatonic, a village at the northern extremity of the town, and in this village are the successfully conducted mills of the Berkshire Woolen Company. The increase of manufacturing establishments and the introduction of new industries into the town would be hailed by many as an evidence of increasing prosperity, and while such an increase in the population might afford a better market for agricultural products, it is extremely doubtful if a growth in such direction would add to the permanent prosperity of the town, for its chief attractions are, and ever should be, those qualities which make it desirable for country homes. That this feature is being appreciated is shown by the strangers who seek its hospitalities in increasing numbers each succeeding year.

The manner of caring for the material interests of the town may possibly contribute to its popularity in this respect. We have about seventy miles of road and fifteen bridges, which are kept in repair at an annual average expense of about $4,000; the policy of the town, in late years, having been to *get the best.* We have now eight substantial iron bridges, which number will be increased as the remaining wooden structures need replacing.

The educational institutions of the town constitute a feature in which the inhabitants feel a commendable pride. We maintain a first class high school, two grammar schools, and seventeen primary and intermediate schools, with an attendance of something over 800 scholars, for the support of which we paid, in 1883, the sum of $9,532, besides something more than $1,500 for repairs of school buildings.

We have a free public library, containing three thousand and five hundred volumes, organized and supported wholly by private liberality until the present year, when the town voted an appropriation of $1,000 for its benefit, having previously, however, provided a room for its use in this building.

Recognizing the fact that the past is the security for the future, the town, at its annual meeting in 1881, voted to procure the publication of a history of the town, and appropriated money and appointed a committee to carry that vote into effect; the result of which is a history by one of the native citizens of the village, from material previously gathered, and which I have been assured by our venerable associate, Col. Wilder, is the best-written town history he has ever seen. I think you will agree with me that it could have no higher commendation. I have drawn from it quite freely for the few historical facts I have presented.

But you, perhaps, are more interested in the agriculture of this locality than in its other features. I can say of that, in a general way, that it is very simple and its scope very limited. The earlier settlers raised wheat, corn, oats and flax, made some pork, and fattened considerable beef on their nutritious pastures; the latter being taken by drovers to the distant markets, while the other surplus products were mostly carried to the Hudson River, about thirty miles distant, to be shipped thence to New York, the farmers bringing back, for the country merchants, such goods as their trade required, and bringing also, considerable quantities of Nova Scotia plaster, which was extensively used as a fertilizer. This system was gradually changed. The raising of wheat and flax was practically abandoned and dairy and sheep husbandry became the principal factors in the agriculture of this region, to be modified later, by dropping the sheep and substituting what may be best described as *mixed* farming; and such is the agriculture of Southern Berkshire to-day, with the addition of stock raising to a limited extent.

With not an incorporated city within the county, with no large manufacturing villages accessible, nearly a hundred miles from any available market, with no surplus labor obtainable, the range of successful farming seems exceedingly narrow and calls for the exercise of industry, skill and economy. To encourage these qualities the Housatonic Agricultural Society was organized, and although its incorporation was opposed by the older society of the county — the

Berkshire — events have proved that with societies, as with farmers, there need be no unpleasant rivalry, no disastrous competition. The field of usefulness is large enough for the well-directed labors of all.

In the case of the Housatonic, if its usefulness has been in keeping with its growth and material prosperity, its existence has certainly not been in vain. From very small beginnings it has grown to a leading position among the institutions of the State. As an illustration of its growth we have one of its earliest schedules of premiums offered, amounting in all to *one hundred and eighty-two dollars*, which meagre sum was secured by the persistent efforts of the few who were interested in the enterprise. The total disbursement of this Society for the current year, will aggregate between *five and six thousand dollars*. Just how much of the manifest improvement in the agriculture of the vicinity is due to the influence of this Society it is impossible to estimate, but certain it is, that a great change for the better is indicated by the improved stock, by the better cultivated fields, and by the evidences of comfort and refinement that mark the homes of the farmers. And we believe that our Society has contributed largely in effecting *all* of these results; for while its efforts have been mainly in the direction of practical and profitable agriculture, the æsthetic side of farm life has not been overlooked. One or two instances in this line I note with pleasure.

The Society's list of premiums offered for 1875 contained, beside the customary list, this announcement: —

"A resident of Great Barrington, desiring that the town should be further beautified, and believing that the cultivation of forest and ornamental trees increases the value as well as the beauty of the country, offers $200 in premiums, viz.: — One of $100, one of $60, and one of $40, to persons competing therefor in the above work on the following terms: The trees are to be set in the autumn of 1874 or the spring of 1875, within the distance of five miles of the iron bridge in said town, and the forest variety must consist either of the elm, white-ash, rock-maple, white-oak or walnut, preference being given to trees of the above kinds in the order in which they are named. The selection of ornamental trees is left to the choice of each competitor. One-eighth of the trees may be set out on competitor's land for the purpose of ornamentation, the rest in the public highways within the limits aforesaid. No tree to be less than 9 feet high, and those in the highway to be set at least 50 feet apart. Each competitor is to give notice in the month of August, 1875, to the Secretary of the Housatonic Agricultural Society that he is a competitor for the above premiums. In the month of September following, the trees to be viewed by a committee of three men, one from each of the towns of Stockbridge, Sheffield and Egremont, to be appointed therefor by the executive committee of the Housatonic Agricultural Society. No one shall be entitled to receive the first premium ($100) who does not show at least 75 trees; or the second premium ($60) who does not show at least 45 trees; or the third premium ($40) who does not show at least 30 trees, living and growing at the time of such view. The committee, in awarding the premiums shall consider, among other things, the number, kind, size and symmetry of the trees, and the award shall be final and absolute."

The awards were made and the premiums paid in accordance with that offer, and not only for the liberality of the gift, but for the opportunity which his example suggests to others, the name of Calvin Rood of Great Barrington, deserves to be gratefully remembered by the generations who are to enjoy the results of his disinterested munificence. Acting upon the suggestion thus offered, the Housatonic Society have, twice at least, offered premiums of $100, for the same purpose and on similar conditions, except that the limits of competition extended throughout the county; and in the autumn of 1879, I had the pleasure of acting as committee to award the Society's premium, and found as the direct result of that offer more than six hundred trees set and being cared for in compliance with the conditions imposed. Who can doubt that some of those trees will beautify and make pleasant the waysides of Berkshire, when those who planted them shall have been long forgotten?

I have, gentlemen, imperfectly outlined a few events in the history of the town and of the Society whose guests you are.

Mr. Joseph A. Kline, President of the Housatonic Agricultural Society, was then introduced, and spoke as follows:

ADDRESS OF Mr. JOSEPH A. KLINE.

Gentlemen of the Board of Agriculture, — I see men before me whose hair is white with threescore years and ten, who have been identified with this Board from its birth, and whose efforts, in co-operation with those of the other members of the Board, have made it what it is, and it is from these men you should have selected some one to speak in my place. But, gentlemen, as a young man, I heartily welcome you. Why? Because you have taught us how to make use of fertilizers; you have taught us economy in all the operations of the farm, and it is for that we greet you here to-day. By the Agricultural College and the experiment institutions founded by your exertions, you have educated our young men to know the different soils, to know to what crop each soil is adapted, to know what fertilizer each crop requires, and also to know what crop to feed for certain results; and, thus educated, the intelligent farmer may carry on his business with little waste.

We have been looking forward with great anticipations ever since you accepted our invitation to meet with us this winter. We came up here to fill our storehouses with knowledge for future consumption, and this audience is anxiously waiting for you. Your time is limited, and I will not occupy it. (Applause).

The CHAIRMAN. I now have the pleasure of introducing Mr. John W. Pierce of West Millbury.

WATER AND ITS SUPPLY FOR OUR CROPS.

BY JOHN W. PIERCE, OF WEST MILLBURY.

There are five conditions, largely under the control of man, which are essential to successful agriculture: —

1. Good seed.
2. Suitable soil.
3. Effective tillage.
4. Available plant-food.
5. The proper degree of moisture.

If these conditions all exist, success is assured; and while the full compliance with either may, to a certain extent, be a substitute for a partial failure of other conditions, yet the highest success is only obtained by the complete fulfilment of all.

Without good seed we cannot expect success, yet, other conditions being favorable, we may avoid an entire failure. Neither can good seed planted on soil not suited to its growth meet high expectation. Or, if the seed and soil be good, there will not be success unless the earth is well prepared for the reception of the seed, and it is carefully planted, and the plant tilled until grown. Fertility will induce a fair growth even if seed and tillage are defective, but this can only be a partial substitute for the failure of other conditions. However good the seed may be, and though planted on a kindly soil, with the most careful tillage and an abundant supply of the elements of plant-food in the right proportions, yet if the supply of moisture be either largely deficient or excessive, our efforts will meet with disappointment; for while, other conditions being favorable, crops will grow on a scanty or excessive amount of water, yet such growth is sickly and feeble compared with what it would be with a well-regulated supply.

If, then, we recognize that the supply of water is one of the essential conditions of successful agriculture, and that it is, to a large extent, under our control, it becomes a matter of vital importance to the farmer to understand the extent of his power and to exercise it to his greatest advantage. Water covers nearly three-fourths of the surface of the earth; it also is present in the air, soil and rocks; it furnishes a large part of the weight of all living organisms, both animal and vegetable; it is also present in most substances which we call dry, and even in many saline substances, in the form of water of crystallization.

Water has the power of absorbing heat, and of parting with an equal amount as it cools. It is this power which keeps the wet soil cold in spring, and the sun warms it so slowly that he nearly reaches his summer solstice before steady warm weather prevails. In autumn the water helps to retain the heat long after our part of the earth has turned from the sun's direct rays. Thus a wet spring is colder than a dry one, and a wet season in autumn is, to a certain extent, a protection from frosts. The close proximity of large bodies of water is a great protection from early frosts, because they absorb and hold heat, which they give off slowly during cold nights, and the vapor arising from the water checks the radiation of heat. Water forms from 20 to 90 per cent. of the weight of growing vegetation. Plants live and grow only by the aid of water, which dissolves their natural food and enables them to assimilate it. To accomplish this, plants must have a liberal supply of water within reach of their roots, but they go deep to obtain it, and in such cases it would appear that they either find their food in the subsoil or else take a part of it in a nearly dry state from the surface soil where we usually apply it. We often see crops grow vigorously when the surface soil is apparently dry. In cultivating corn, which always has a great root development, I have often exposed quantities of fibrous roots where the soil was dry enough to be dusty. Is it not possible that plants have the power to take water from the subsoil with the lower roots, and to carry it to the surface or feeding roots, and there, with the water so carried, dissolve and take up the dry plant-food? Are not vegetables, like animals, able to take their food and drink separately, and to moisten the dry food with their own secretions?

Professor S. W. Johnson, in "How Crops Grow," page 254, gives the result of a single experiment, by Henrici, which confirms this theory. In this experiment a young plant was set in a glass funnel filled with garden soil. The funnel was supported in a glass jar, with the lower end just inserted in the water in the jar. The soil in the funnel was kept moist until the plant was well rooted. After several weeks the roots extended through the empty neck of the funnel and developed rapidly in the water, after which the soil was not watered, but care was taken to maintain the supply in the jar. The plant continued to grow, but in a feeble way, and the roots in the dry soil of the funnel remained fresh, and it is evident they must have absorbed nutriment from the dry soil, although that does not appear to be the object of the experiment. Whether plants can use dry food or not, is a question to be settled only by careful experiments, but we all know that water must be continually within reach of their roots or they cannot grow. Substances which are inimical to vegetation may often be removed from the soil by water. We are told that the alkaline plains of the American desert only need water to dissolve the poisonous salts, when they will become fertile. Rain purifies the air by the power of water to absorb its impurities. Sickness is more prevalent during a protracted drought, and is often checked by a heavy rain. Through our sewage systems water removes the wastes of civilization and enables us to secure that cleanliness of person and surroundings which is so essentially a part of civilized life. It has been said "that the amount of soap used by a people is an indication of the height of their civilization," but is it not more properly measured by the amount of water they use?

Water in nature is in constant motion. It is volatile at all temperatures, and evaporation is continually going on from the surface of all bodies of water, as well as from the soil, from vegetables and from animals. This vapor of water is blown about by the winds, and condensed on cold surfaces, or by colder currents of air, into clouds, and from them precipitated in rain, hail or snow. A part of what falls on the land flows immediately back to the ocean by brooks and rivers. A larger part is absorbed by the soil, and given up slowly, as it percolates through the earth and escapes to the water-courses, or is taken up by the roots of growing plants, or evaporated direct into the air. The soil acts like a sponge, absorbing water and giving it up slowly to vegetation and the atmosphere. It is with the part which is absorbed and held for vegetable use by the soil, that we farmers have principally to deal. The absorptive power of different soils varies greatly. Some soils, by their mechanical condition, absorb and hold a much larger part of the rainfall than others. The annual rainfall in the New England and middle Atlantic States is 27 to 45 inches.

From the report of the Chief Signal-Service Officer, I find the average rainfall at Boston for ten years to be $49\frac{1}{2}$ inches, with a variation of from $37\frac{1}{3}$ in 1880, to $65\frac{1}{2}$ in 1878. At Albany for seven years, the average was $38\frac{3}{4}$, with a variation of from $32\frac{1}{2}$ in 1880, to $49\frac{1}{3}$ in 1878. We may safely take the average of these observations at the two stations of Boston and Albany, as an average for the State of Massachusetts. We then find the average annual rainfall for our State to be 44 inches, with 35 inches for 1880, which was an exceptionally dry year.

A great amount of water is required by plants to supply the evaporation from their leaves. This water is all taken up from the soil by the roots. The amount required depends largely on the kind of crop, and the condition of the surrounding air. On a hot, dry day, evaporation is often excessive, and if the supply of water is not abundant the plants wilt.

Sir J. B. Lawes found that common plants exhaled, during the five months of their growth, more than two hundred times their dry weight of water. This water is all drawn from the soil. Dr. J. H. Gilbert, in a pamphlet on "Rainfall, Evaporation and Percolation," says, that "the amount of water given off by plants during growth might be roughly estimated at a depth of three inches of rain for every ton of dry substance grown." According to this estimate, a crop of three tons of dry fodder (which is a large crop) on an acre, would require nine inches of rainfall, provided it was all utilized by the crop. This is a large amount of water, yet it is but twenty per cent. of our average rainfall. In Southern California a rainfall of ten inches has secured abundant crops, and fifteen inches is considered sufficient, if evenly distributed through the wet season. It is quite evident that our rainfall, provided it could all be utilized, would be very much more, even in dry years, than the amount required by our crops.

If, then, our annual rainfall is more than equal to the demands of our crops, how is it that they suffer so severely from droughts during portions of almost every season? It is because the rainfall is not evenly distributed through the season. We get too much at times, and then for weeks, or even months, we receive only a scanty allowance. This is particularly true of the summer, when the crops are growing and need the most; while at such times the evaporation is excessive, both from the leaves of vegetation and the soil. Summer droughts are the common accompaniment of our New England summers.

The Secretary of this Board, in his last annual report, truly says that: "The thirty volumes of our reports are, with several exceptions, a record of drought. It is almost as certain to come as the summer. The Massachusetts farmer must prepare to meet it, and so plan his operations as even to turn it to his account."

But we have another difficulty here with which to contend; on all but the lightest soils, excessive rainfall during the growing season is nearly as ruinous as excessive drought. I have found that I can make the dry seasons the most profitable and satisfactory. Droughts and floods of rain in our climate are not confined to any particular season of the year, although they are more injurious, and for that reason more noticeable, in spring and summer than in the other seasons.

The problem which presents itself to us farmers is, whether we can, in any practical way, regulate this supply of water, so as to rid the land of the surplus in a wet time, and to retain a part of it for use when needed, and so secure a more constant supply. Nature does not distribute her blessings to us gratuitously, but requires us constantly to work and struggle to obtain them. She mixes the good and bad seed together and requires man to select the best, from the mass of bad. He must also select and prepare a suitable soil, and must till, feed and water it to obtain his reward. If his soil has become exhausted of certain elements of plant-food, he must procure those elements in manures and apply them to the soil in the needed quantities. The fact that vast quantities of potash exist in the mines of Germany, nitrate of soda and guano in South America, or phosphate of lime in the river beds of South Carolina, will not make our crops grow, unless we obtain these distant materials and apply them to our soil. So, too, the fact that we have an abundant supply of rain during the year, does not meet the needs of our crops, unless we secure to them its benefits during the whole growing season. We must water as well as feed our crops.

But first, how can we dispose of the surplus water when there is too much? This may be done by drainage, and to a certain degree by tillage. All soils which are so destitute of natural drainage as to be too wet for cultivation early in the spring, or during a rainy season, should have artificial drainage. Where stones are plenty, they make excellent drains, and if properly laid and kept covered, so as to keep the surface water out, and the outlets are kept open, they will last a long time. Where stones do not abound, tile is the best material to use.

On stony farms, where stone heaps and old walls are abundant, the advantage of thus disposing of the stones will often nearly equal the cost of the drains. Heavy soils, well drained, make the most profitable lands, especially in dry seasons. I find that on such soils it does not take more than half as much manure to produce the same crop as it does on the naturally dry lands.

Tillage will accomplish much toward rendering a wet soil dryer. The ploughing and pulverizing of wet soils, when it can be done, will hasten the drying and warming of the surface, and sooner fit them for the seed. Ploughing a wet soil loosens it and admits the air and heat of the sun, and exposes more of it to the drying winds. It also breaks, to a certain extent, the capillary connection with the subsoil, and thereby checks the ascent of water from below. While it is not wise to plough soils when too wet, it is well to start the plough as soon as possible. Wet, heavy land may also be made lighter and dryer by continued tillage for successive years. I have found by experience that the continued tillage changes its character and makes it more porous and lighter, so that each successive season the surplus water soaks away or dries out more rapidly.

These means for rendering a wet soil dryer are simple and easily carried out, but a more complicated and difficult problem presents itself herein; how to retain the water for use when needed, and to apply it at such times. This may be done by the primitive method of making reservoirs on streams and carrying the water by canals to the fields, and there distributing it by ditches; but this is impracticable on most of our farms, and expensive under the most favorable conditions.

Where water can be had from public water works the crops can be supplied by a hose and sprinkler, without great expense, except for the water rates, and under such conditions can often be used to great profit. But such opportunities for procuring water are exceptional, and usually the only available means are pumping by wind or steam, and distributing by pipes and hose. The erection of such conveniences has been made very profitable to extensive market gardeners on valuable lands, but it is not within the means of the majority of the farmers of our State. There are also serious objections to the artificial application of water to the surface in dry weather. Such applications of water tend to increase the evaporation from the soil, which at such times is naturally excessive, owing to the dry state of the atmosphere; it also has the effect of compacting the soil, which tends largely to increase that evaporation. It also has the effect of bringing the roots nearer the surface, where they are more liable to feel the hot sun, and to suffer from any failure of a constant supply of water. The artificial application of water increases the demand for its use, and when once commenced renders a constant application of it necessary. But there are other means for protection against drought.

Dr. E. L. Sturtevant, in three years' observations on the percolation of water through the soil of his Lysimeter at South Framingham, found that of the annual rainfall of 47.15 inches only 8. 7 inches or 17.9 per cent. percolated through the 25 inches of grass-covered sandy soil of his Lysimeter.

Prof. Stockbridge, in observations covering the seven growing months of the season, found, out of a rainfall of 25.7 inches during the time observed, a percolation of only 5.14 inches, or 20 per cent. of the amount of rainfall, passed through the 36 inches of soil in his Lysimeter at Amherst.

By these observations, conducted in our own State, in both cases on leachy soils of only 25 and 36 inches depth respectively, we are shown the great absorptive power of our poorest soils. In both cases all the water which fell on the surface was forced into the ground, and none of it allowed to flow off, as it often does when unobstructed.

If such shallow depths of porous soil can absorb and hold until given off by evaporation, so large a per cent. of the rainfall, it would be interesting to know how much of it a retentive loam of a much greater depth could hold. I think that these observations indicate to us the practical way to secure the water supply for our crops. And that is: 1st, to increase, where it seems to need it, the absorptive power of the soil, and 2d, to check evaporation in dry weather, so far as we can, in order to retain the water which the soil has absorbed for the use of our crops.

Soils which are deficient in absorptive power are usually coarse, sandy or gravelly soils that are deficient in vegetable matter and in clay. Such soils may be improved by tillage, and by the application of clay and vegetable matter. Such soils need dressings of stable manure and muck, or the turning under of green crops to furnish the needed vegetable matter. The greatest obstacle to the continued cropping of light soils with chemical fertilizers only, is the exhaustion of the supply of decaying vegetable matter in the soil, rendering it heavy and destitute of absorptive power, and in dry seasons, crops on chemical manures are more apt to fail for want of sufficient moisture than when stable manure is used. Therefore, when chemicals only are used, care should be taken to grow crops of extensive root development, or to occasionally turn under a green crop.

Deep tillage before the crops are planted, and during the early part of the season, before the root development becomes extensive, will help them to withstand drought. Deep ploughing and subsoiling induce a deep root development, where the soil is cool and moist, below the dry strata. Successful market gardeners practice deep tillage, but they always associate it with heavy manuring. Do not think I recommend deep tillage without heavy manuring. Shallow soils can only be successfully deepened by gradually working a little deeper each year.

The benefits of deep tillage by subsoiling are forcibly illustrated by experiments conducted by Prof. J. W. Sanborn of the Missouri Agricultural College, and reported in Bulletin No. 5 of that institution. In these experiments, two adjacent plots of $\frac{1}{10}$ acre each, were ploughed 7 inches deep, and one of them was subsoiled to an additional depth of 9 inches, or stirred 16 inches deep in all. After drought had become very severe, samples of the soil of both plots were taken, to a depth of 15 inches, by driving a gas-pipe to that depth. The samples taken from the subsoiled plot were found to contain 10.1 per cent. of moisture, while the samples taken from the unsubsoiled plot contained only 8.33 per cent. of moisture. The yield of corn was also much the best on the subsoiled plot, yielding at the rate of 70 bushels per acre, while that on the unsubsoiled plot gave only 49 bushels per acre.

Mulching is also a means by which evaporation can be checked and the water supply retained. A mulch produces this effect by shading and protecting the soil from the beating rains, drying winds, and the rays of the sun.

The rain, beating on the soil, not only compacts it, it washes the fine particles into the non-conducting air spaces, and thus forms fine spaces, or active capillary tubes, through which the subsoil water is rapidly conducted to the surface; this process goes on with great vigor of action when the surface of the earth is hot under the sun of long summer days, and fast exhausts the water in the subsoil. Any non-conducting material which shades the ground without allowing a circulation of air between it and the soil, will serve as a good mulch, and keep the soil loose, cool and moist. Dry hay, leaves, saw-dust, chip dirt, boards, dry sand, or even loose, dry soil, are all good mulches. That mulching does serve to retain the moisture, is evident to any one who has tried it, and noticed the increased freshness and vigor of mulched plants during dry weather.

Prof. Sanborn, by experiments at the Missouri Agricultural College (Bulletin No. 4), found, after a continued drought of four weeks, that samples of soil taken six inches deep, from heavily mulched ground, contained 10.5 per cent. of moisture, while samples taken at the same time, from unmulched ground, contained only 5.62 per cent. of moisture, and that the mulched soil was very much cooler, and yielded a better crop than the unmulched.

In experiments on fodder-corn, I have found that either an effective mulch of meadow hay, or pieces of old boards, or a similar condition produced by frequent tillage, had about the same effect, the dry surface caused by the tillage acting as a mulch. That a layer of loose soil obtained by tillage is a mulch, is further shown by the experiments of Prof. Stockbridge, Dr. Sturtevant, and Prof. Sanborn. Each of those investigators found more water in certain depths of soil where the surface was tilled, than where it was untilled, which fact indicates that tillage checked the evaporation.

In the experiments of Prof. Sanborn, previously referred to (Bulletin No. 5), when samples of soil were taken near the close of a hot day, the first 3 inches of tilled soil contained a trifle less moisture than the first 3 inches of untilled soil, but the second 3 inches of tilled soil contained very much more than the second 3 of the untilled; and in all cases, day or night, when samples were taken to a depth of 6 inches, those from the tilled soil held more moisture than those from the untilled.

If then, light dry soil obtained by tillage is a good mulch, which will check the evaporation and serve to retain the moisture of the soil for our crops, it is certainly a cheap and always available means of accomplishing this end, and is within the reach of every one, and the farmer who neglects such an available means of protecting his crops from drought, which is almost as sure to come as the seasons, has no reason to complain if his more enterprising neighbor's crops grow when his own fail.

To recapitulate: I have attempted to show that our crops require a large amount of water, but that our annual rainfall is always much greater than the needed amount, provided it could be made available at all times; that all soils have the power to absorb a large amount of water and hold it until carried off by evaporation; that all that is needed on good soils to protect our crops from injury by drought, is to increase their absorptive power by the addition of vegetable matter or clay, and by mulching to check the excessive evaporation; and that a mulch of loose, dry soil, to be obtained by frequent tillage, is a good and practicable means of obtaining it.

In the practical application of these principles, we should select the most retentive soils, and if their natural drainage is imperfect, secure good drainage of surplus water by artificial means. On such soils, to hasten their drying in spring, we should start the plough as early as it can be used without making the soil lumpy; for by ploughing the moist soil in early spring, we break the connection with the capillary tubes which bring the water up so rapidly from the subsoil, and by admitting the air we dry the surface and lower the evaporating point. After we have planted the seed we may roll the surface, and so compact the soil and restore the power of evaporation to the surface, so that the shallow planted seed may be kept moist. After the plant has come up and its roots get hold of the soil, we must by tillage loosen the soil, which dries the surface but at the same time checks the evaporation from the subsoil. This tillage should be continued as long and as deep as possible without injuring the roots of the growing plants and as often as the surface becomes compacted by rain or otherwise. By such a system, on good land, we can laugh at drought, unless more protracted than it often is in our climate.

The CHAIRMAN. Gentlemen, — Any questions pertinent to the subject which has been presented are invited from the audience. The lecturer is ready to respond.

Mr. BEEBE, of Great Barrington. Deep tilling of the soil does very well where the subsoil is not barren. All the question about ploughing deep or shallow arises from the difference in soils. A great many subsoils are cold and infertile. If you stir such soil, you injure the land. The reason why soils are damp that are tilled deep, is because the air circulates through the soil, and the soil being colder than the atmosphere, the cold condenses the moisture. I believe that is the whole secret of it. It is, so far as my experience goes.

Mr. PIERCE. The gentleman has touched upon a point which I meant to have introduced into my lecture; but all through this paper I have struggled against length. I found that I had attempted too much; I have had to condense, and I had no time to enter upon this branch of the subject. And, furthermore, when I got through, I made up my mind that the doctrine which the gentleman announces had been so exploded that it was useless to bring it up here. The facts are positively against that theory. In the first place, if what the gentleman says is true, the soil must be colder than the air; but the experiments of Prof. Stockbridge, Prof. Sanborn and Prof. Penhallow, at Houghton Farm, have all demonstrated that, during the summer, with very rare exceptions, the temperature of the soil is higher than that of the air. The old idea was, that the soil in dry weather was watered by the dew; but that could not be, because the soil is warmer than the air. Consequently, the air absorbs the moisture as it rises from the soil, and when dew is deposited, it is because the air becomes saturated with water, and as it cools through the night, the lower stratum of air is not so cold, it has more moisture than it can hold, and in a cloudy night it rises up, and coming in contact with colder air, it is condensed, and drops upon the surface, and there it remains until the sun comes out and dries it. All you practical farmers know that if you cock up hay at night which seems dry enough to get in, you will find that hay much damper the next morning than it was the night before. That water comes out of the soil, and condenses in the hay just before it escapes into the cold air. Now, if that hay, instead of being cocked upon the ground, had been loaded on a cart, you all know there would not be much more moisture in the hay on the cart than there was the night before.

Mr. Beebe. I have put up a great many cocks of hay. Hay is generally cocked up because the small leaves are green, and, apparently, it is not sufficiently cured, and you may look at it the next morning, and you will see that the moisture comes out of the largest stems of the hay, not out of the ground.

Mr. Pierce. Is not that hay left on the cart drier the next morning than if it had been cocked? That is the practical question. I procured the documents from Prof. Penhallow, Prof. Sanborn and Prof. Stockbridge, and I have brought you the practical conclusion.

Mr. Ware, of Marblehead. Reference has been made to two systems of drainage in the essay; one by digging trenches and filling them with loose stone, and the other by laying tile. I do not know as the speaker intended to be understood that it is better, as a matter of economy, to drain with stone, if you have the stone, in preference to tile; but he placed stone drains first in order, and tile drains second. I am well aware that on many farms it is very desirable to get rid of the stones, and if there is no other way to dispose of them, it may be profitable to put them into drains; but as a matter of economy in building drains, it is more expensive, I am very sure, to build a stone drain, even if you have them lying alongside, in heaps or otherwise, where the drain is to be laid, than it is to buy the tile and place them in the trench properly. A stone drain is more expensive, and not as effective. Therefore, as a system of draining, it seems to me that the tile system should have been placed first in order, as a matter of economy, and as being more efficient. But if the object is to get rid of the stones, it does furnish an opportunity to dispose of them as cheaply, perhaps, as they can be disposed of in any other way.

Mr. J. B. Moore, of Concord. I think Mr. Ware is exactly right. I do not speak from theoretical knowledge; this is one of the things I know about. I happen to have a number of miles of drains. I know that one of my neighbors drained four or five acres with stone, and those drains, in the course of ten or fifteen years, became useless, and the land had to be drained with tiles. I know, further than that, that if the soil in which the ditch is to be dug is hard, it is cheaper to excavate such a trench as is needed to lay tiles, than it is to dig the larger trench which is required to put the stone in, even if one of your neighbors would haul the stone with which to lay the drain. I know, too, that a tile drain is infinitely better, and will deliver the water four times as fast as the other.

Tillage is a very important thing in the growth of crops, and very important to prevent drought, which is the rule and not the exception of our climate, as the essayist has said. Constant tillage through the summer will obviate the ill effects of a drought, but there is another reason for tillage to which allusion has not been made. If you have omitted to stir your soil, and that soil has become baked and hard, when there comes a shower, if you go down to the brook, you will find that the water has gone into your brook; but if that soil has been stirred four or five inches deep, — as deep as an ordinary steel-toothed cultivator will stir it, — then, when a rain comes, your plants will get the benefit of it.

Mr. ——. I will ask gentlemen who have had experience in drainage if it would not be a good plan to lay a stone drain and place tile in the bottom of it?

Capt. Moore. All the water that comes into the tile comes in at the bottom, if it is well laid. You don't want any surface water drawn in at the top of your drain, for that is what fills your drain up.

Mr. W. R. Sessions, of Hampden. I do not agree with those who claim that tile drains are better than stone drains, in all cases, because men who live among the hills have pieces of land to drain that are by no means level; they are sometimes quite precipitous. I do not need to tell any one that a drain where there is plenty of fall will not fill up, and in those cases a stone drain is just as good as a tile drain, and gives you an opportunity to dispose of the stones, which are a nuisance. I know of stone drains in my own town, — not laid stone drains, but ditches filled within about a foot of the surface with small stones tipped out of a cart, — that have been there for some twenty-five years, and they are as efficient as any drain can possibly be. They are in a close soil, and there is plenty of pitch to carry the water off.

Let us be careful about undertaking to lay down an arbitrary rule that shall prevent our taking advantage of our circumstances. Let us be careful about laying down as an axiom a rule that has its exceptions. I believe that the essayist recommended stone drains where there were stones to be disposed of, which would offset the difference in expense between stone and tile drains; I don't think he put stone drains first because they were the best, by any manner of means.

Mr. Pierce. I hope I have not been misunderstood on this point. Mr. Sessions states my meaning. My essay was designed for the class of practical farmers, who wish to improve their farms and secure the best crops they can with a limited outlay. I spoke of irrigation from public sources of water supply as being desirable where men had valuable land for market gardening and sufficient means to carry on such operations; and in case of those who had not the means, or were not so situated that they could resort to irrigation, I spoke of tillage as a substitute. But in regard to drainage, there are many farmers who, like myself, have a great many stone heaps and stone walls, very difficult to get rid of. They are a nuisance on the farm, and the question is, what shall we do with them? We have either got to excavate and put them into drains, or else cart them to some pasture and perhaps pick them out again afterwards. Is it not better to make large ditches and put them in and thus get rid of them once for all? I dig a great many drains at odd jobs, when the weather is unfavorable for other farm work, so that the expense is not great. I am now taking up a ditch which my father put in several years ago. It is not serviceable. Why? Because he dug that ditch not over two feet and a half deep. I am digging that ditch about a foot and a half deeper, and I am laying the culverts with a great deal of pains, so that the frost will not affect them. I admit that a tile drain is the best, but I do not use tile. I do not think it will pay me to buy tile, while I have so many stones that I want to get rid of.

Mr. Ware. The great question seems to be, how to get rid of the stones. There is no question but that it is cheaper to lay a tile drain than it is to make a stone drain, but we want to get rid of the stones. How many of us have farm roads that we are carting over continually with the wheels half way to the hubs? Why not dig out those roads, put the soil where it will do some good, and fill them in with stone, and make serviceable roads, that will last? Stones are needed in the bottom of every road, the soil can be much more easily taken out than you can dig a deep trench for a drain, and you can cart it at very little expense compared with the cost of digging a three-foot trench. A trench for a drain should never be less than three feet deep — four would be better. Therefore, as a matter of economy in labor, which is the great expense of farming, it is desirable to lay tile rather than to build stone drains. The cost of the tiles is nothing in comparison with the additional cost of digging these expensive trenches.

Adjourned to two o'clock.

AFTERNOON SESSION.

The Board re-assembled at two o'clock, and the Chairman introduced as the first speaker, HENRY J. BARNES, M. D., of Boston.

UTILIZATION OF SEWAGE.

BY HENRY J. BARNES, M. D.

In 1864 Mr. Darwin E. Ware addressed the Essex Agricultural Society on the utilization of the sewage of cities. "The subject (he says) has vital relations to the progress of civilization. Through the sewers of cities discharging into the ocean the highest properties of the soil are irrecoverably lost. The turbid currents of the North River, the Thames and the Seine are richer than Pactolus with its sands of gold. For that which is pollution to their waters is the touch of magic to the fields, and the power of food for successive generations of men. . . . . The invention of a plan by which the slime and sediment of cities can be transformed into corn and wheat, gives scope for one of the most beneficial systems of economy yet devised."

Liebig says of the *cloaca* of Rome discharging in the Tiber: — "It swallowed up in a few hundred years all that could make the Roman peasantry prosperous, and when their fields were no longer able to produce the necessaries of life for the Roman people, then were the riches of Sicily, Sardinia, and the fertile coasts of Africa irretrievably sunk in this *cloaca*."

"The value of this material as a fertilizer is obvious, but it has been comparatively estimated, and put beyond controversy by the experiments of the Prussian government reclaiming lands with the sewage of Dresden and Berlin. Land which without any application yielded but three for one of seed sown, and seven for one when treated with the ordinary resources of the farm-yard, yielded fourteen for one when fertilized by sewage."

Gen. N. N. Halsted read a paper before this Board in

1877 on the "Management of Night Soil," and quoted from the highest authority to establish the great value of human excrement as a fertilizer. The analyses of Berzelius, Lehmann and many others, agree in showing its richness in plant-food.

"The eminent agricultural chemist, Liebig, quoting Boussingault, speaking of value of night soil as compared with other manures, says, on the assumption that the liquid and solid excrements of man amount, on an average, to only a pound and a half daily (a pound and a quarter of urine and one-quarter pound of fæces), and that both taken together contain three per cent. of nitrogen, then in one year they will amount to five hundred and forty-seven pounds, containing 16.41 pounds of nitrogen — a quantity sufficient to yield the nitrogen of eight hundred pounds of wheat, rye, oats, or nine hundred pounds of barley. . . . . One hundred parts of the urine of a healthy man are equal to thirteen hundred of the fresh dung of a horse. . . . . The activity of night soil as a manure is one of its chief advantages; and this, in a great measure, is due to the very large proportion of azotized principles it possesses. It is from this azot, ammonia is derived, and it is ascertained that a man passes nearly half an ounce of azot with his urine every twenty-four hours."

Gentlemen, I assume it is not necessary for me to quote further facts showing value from an analytic point of view. The rich nitrogenous food upon which the human race subsists, must, of necessity, produce a valuable fertilizer. The discussion which follows the paper referred to, indicates that, in practice, no such qualities are found by many of the farmers; that they considered it a poor fertilizer, and some would not take it as a gift. I am informed there are but few farmers in the vicinity of Boston who will allow it on their farms. Thus there appears the proverbial difference between theory and practice. But it is a difference which consideration will reconcile. Because farmers find no value in it is not proof that it never contained any. Six-sevenths of the fertilizing matter thrown into a vault or cesspool is soluble. If the walls are pervious, as is the case with many, not one particle of this can be arrested by the process of filtration thus established, or by any other mechanical filtrage. A solution of morphine loses no strength because of filtrage. Again, most of our city vaults have overflows into a neighboring sewer, and, drenched with floods of water, the soluble matter is washed away, leaving only a worthless sludge. The long intervals between the periods of emptying are sufficient for complete decomposition of the nitrogenous matter. The ammonia is lost in the atmosphere or carried away by the overflow.

To-day St. Petersburg, Odessa, Vienna, Rome, Naples, Brussels and London are perplexed to know what shall be the final disposal of the detritus of these great cities. It is but a few years since London completed her great metropolitan sewer to discharge at ebb tide twenty-one miles below the city in the maritime Thames and where the river is about half a mile wide. It has cost the city over twenty-one million dollars. Its successful opening was heralded throughout the world as a great triumph of engineering. It has taken but a short time to demonstrate its failure. She now learns that sewage is not oxidized in water, it is not carried to sea by the tides, it is not diluted to an extent sufficient to render it innoxious, but it is precipitated above and below the mouth of the sewer, and a great cry of indignation now comes from the inhabitants living along the banks of the river. During the past summer twenty-two tons of chloride of lime have been used each day to abate the stench. Boston is beginning to realize the folly of imitating this system of disposal, for already there is complaint along the south shore in the vicinity of Moon Island.

Torquay and Brighton, draining directly into the English Channel, have experienced similar results, and their systems are pronounced failures.

Washington is agitated over the malaria supposed to be caused by the deposit of sewage on the Potomac flats; Philadelphia by sewage in the Schuylkill; Baltimore by a system discharging into the "basin," and threatening destruction to the oyster beds of the Chesapeake. Chicago empties her sewage into her source of water supply. With a south wind and high water in the Chicago River, we are told by Prof. J. H. Long, that "the dirty current may be seen floating from the outlet towards the crib, and that his analyses indicate that the water of the city is polluted by the sewage."

Drinking our own sewage is not quite as revolting as being obliged to drink a neighbor's. By the now somewhat famous Pegan Brook, Boston takes her water mixed with the sewage of Natick from one quarter, and the discharge from the women's prison and the subsoil water from a large cemetery on the other side of the lake.

Hartford, Providence and Worcester, each has its sewage question to dispose of.

Among the pernicious effects of the present method employed for disposal of sewage, is the destruction of fish in the Blackstone below Worcester. The disappearance of cod from the wharves of Boston and the abandoned oyster beds of the upper harbor, and even the clams which formerly were taken in great numbers from Clam Island, have long since put on immortality as a result of too filthy environments. The fish have all been destroyed in that part of Lake Cochituate which receives Pegan Brook. Examples of this nature might be recorded almost without number.

ANCIENT METHODS OF GATHERING SEWAGE.

The pool of Siloam is said to have received the washings of the temple, and the liquid was used for the purpose of irrigating the king's garden. Under the ashes of Vesuvius are found water-closets connected with sewers at Pompeii. In the reign of George the Third, house detritus was excluded from the sewers under penalty of a fine, and among the mound builders of America, remains of systems of drainage have been discovered.

The number of systems by which sewage is gathered in modern times, are comparatively few. Most of the large cities in Europe and America have what is known as the single system, by which sink drainage after traversing a cesspool, the contents of water-closets, and the surface water, empty into a common sewer. The double system, as employed at Memphis and a few European cities, separates the rain water from the detritus of the houses. Philadelphia has the surface drainage, by which sink drains often cross the sidewalks in front of the houses, and discharge in the catch basins at the side of the streets.

The pneumatic system of Capt. Liernur consists of iron pipes connected with the water-closets of the city to be drained. An air-pump creates a vacuum, and simultaneously all the closets are opened in section after section of the city once a day. The contents are drawn to the mouth of the sewer, and finally deposited on the land. It is very expensive, but has found favor in Amsterdam and two other Dutch cities, where the level of the subsoil water makes it extremely difficult to construct any other system. It is claimed that the system is not only self-supporting, but profitable.

The Japanese and Chinese have a bucket system, by which all the excrement is saved, and daily taken to scows in the rivers, or carried at the ends of bamboo poles and deposited in large vats to be manufactured into a fertilizer. A medical friend, who has lived in the city of Tokio, informs me that a servant in his family sold her productions for about eight mills per month. Their horticulture is described as being far superior to anything known in this country, both in amount and beauty of produce. Victor Hugo in "Les Miserables," writes: "Thanks to human fertilization, the earth in China is still as young as in the days of Abraham. Chinese wheat yields one hundred and twenty fold." The immunity which these people enjoy from diphtheria, scarlet fever, and typhoid fever, is probably due to the removal of the waste before decomposition takes place.

CESSPOOLS.

Cesspools are employed throughout the civilized world. Some with impervious walls, and emptied as often as filled; some to overflow into a neighboring sewer; some with pervious walls, allowing the liquid to percolate into the surrounding territory. They have all been suppressed in the German cities of Dantzic, Berlin and Breslau, and their abandonment is recommended by a commission appointed by the government of Paris.

METHODS OF DISPOSAL.

A brief description of all the many and varied methods for disposing of sewage, would occupy more time than is allotted to this paper. I shall only refer to a few of the most important, giving examples of each and the results: —

Downward Intermittent Filtration, Kendal, England.

The population is about 14,000. There are 450 water-closets connected with the sewers, which discharge 868,000 gallons per day. A reservoir of deposit was first constructed, which overflowed on a farm of about fifteen acres, with the object of utilization by agriculture. The area of the farm proved insufficient to epurate the sewage completely, and five acres of filter beds were added. These, with the farm, suffice to purify the water. In 1875 the products of one-third of the farm, consisting of cabbages, beets, celery and rhubarb, sold for $500. Oats and rye on another third, $375, and on the remaining five acres $225 worth of hay was raised, making a total of $1,100 worth of produce from fifteen acres. The application of the sewage cost $550.

The operation of the same system, constructed by J. Bailey Denton, at Abington, Great Malvern and Halstead, England, and at Forfar, Scotland, has proved satisfactory, inasmuch as sufficient matter is eliminated to allow the effluent discharge into neighboring rivers, although it contains a large amount of putrescible matter, as indicated by analyses. It just escapes the ban of the Pollution Act.

Upward Filtration at Birmingham, England.

Population about 350,000. Eight thousand water-closets are connected with the sewers, which discharge about 14,000,000 gallons per day in the river Tame. An injunction was obtained to prevent the discharge in the river, unless the sewage was first purified. A reservoir of deposit was built, and a system of upward filtration, but complaint of the continued pollution of the river necessitated its abandonment. The city then attempted irrigation and agriculture, but this was also enjoined. Finally, after much delay and litigation, the city bought 120 acres of land, and on the advice of an engineer constructed a new reservoir of deposit, where they treat the sewage with thirteen tons of lime each day. This clarifies the water to a certain extent by causing a deposit of about 300 tons per day, which is carted out and buried on the land.

It has been an easy matter to separate material in suspension from drain water by filtration, but as this represents only about one-seventh part of the value of sewage for fertilizing purposes, the process, though simple, has never proved remunerative, and chemists have been employed to suggest agents which would precipitate the soluble matter, which represents six-sevenths of the value. Lime has been employed at Tottenham, Blackburn and Leicester, but the Royal Commissioners report of each a failure, inasmuch as the drain water, after being thus treated, contains a large amount of putrescible matter.

Treatment by Lime and Chloride of Iron at Northampton, England.

To 250,000 gallons of sewage is added about 100 quarts of lime and six quarts of chloride of iron, which are thoroughly mixed, and afterwards passed, by upward filtration, through a layer of calcinated iron eight inches thick. The water comes out without color or odor, and is then allowed to flow into the river. At first there was no complaint, notwithstanding the presence of a large amount of putrescible matter, but later the river became offensive, and the court enjoined the discharge there.

The Complicated "A B C Method of Sillar"

produces a valuable fertilizer. But the residuary water still contains putrescible matter, and notably more ammonia than the sewage before being treated.

Precipitation by Chemical Means at Coventry, England.

Population 40,000. Five thousand water-closets are connected with the sewers, which discharged 2,289,000 gallons of sewage in the river Sherburne. Complaint and litigation was the result. A reservoir of deposit was constructed, after which the sewage was allowed to filter across a gravel bed three feet thick. This proved unsatisfactory, as only solid matter was taken out, and the court again interfered with an injunction. A contract was then made with a fertilizer company, which agreed to epurate the sewage for fourteen years at $3,750 per year, the company engaging to erect building and machinery, and furnish the necessary tools. An extractor first separates the solid matter. The liquid is then run into cauldrons under the first group of buildings. Agitators mix impure sulphate of alumine with it at a boiling temperature. It is then run into a second set of vessels, where milk of lime is added and thoroughly mixed, then discharged alternately into four reservoirs in the open air, which are cleaned every fourth day. The liquid thus treated comes out sufficiently pure, and is allowed to filter over about four acres, and finally find its way into the river. Thirty tons of coal, one ton of sulphuric acid, nine tons of sulphate of alumine, and four tons of lime, are used each week. The company's net loss is about $7,500 each year.

After long and costly experiments the greatest chemists have declared that in practice the only manner to epurate sewage is to send it on the land, which eliminates the polluting elements and fertilizing matter for the good of vegetation and the soil. Dr. Angus Smith, says: "In all cases the best results are obtained by irrigation." And Dr. Carpenter certifies, in a notice read at the International Congress, in 1881, "the only way ammonia could be eliminated from sewage is by irrigation."

A commission, appointed by Parliament, composed of Messrs. Dennison, Frankland and Morton, reported: "The actual resources of chemistry do not permit the hope that the polluting matter dissolved in sewage can be precipitated and sent away by any appliance of chemical reaction, and unless new chemical laws are discovered it is useless to attempt the employment of chemical agents. Epuration must be confided to Dame Nature."

Millions of dollars have been expended in France in chemical experiments, all of which have been abandoned.

Disposal of Sub-surface Irrigation.

The buildings usually have two drains, one for liquids and the other for more solid matter, which, after passing through a flush tank, unites with the first mentioned, and both discharge in a tight settling basin, which overflows into a herring-bone system of two-inch porous tile pipe, laid with open joints twelve or fourteen inches below the surface, five feet apart. Dependent on the character of the soil and the volume of water, a subsoil system for effluent drainage five feet deep may or may not be necessary.

Fourteen inches below the surface is beyond the reach of many forms of vegetation. Although capillary attraction may raise some of the liquid to grass roots, most of it must go by gravitation to the subsoil water. You would not expect much benefit from manure turned under fourteen inches. As a fertilizer it has little or no value, even if the roots should reach as deep. Until the nitrogenous matter becomes ammoniacal by decomposition, a process which does not take place without free exposure to air and the presence of micro-organisms or infusoria, it is absolutely worthless as a fertilizer, a fact recognized by every farmer in working over his manure heap when he wishes to receive immediate benefit from its use. The continued presence of water retards oxidation. Timber put in the Thames at the time of the Roman invasion of England, nearly two thousand years ago, is still in a good state of preservation. It is at or near the surface of the land, where organic matter decays, and thus becomes food for plants.

Schloessing records an interesting experiment, showing the influence of the infusoria in the process of purifying sewage when used in irrigation.

A hollow column six feet in height was filled with earth in a manner to reproduce exactly the soil as found at Gennevilliers. Through this was passed sewage in a relative quantity to that employed in irrigation, and at equal intervals with its use on the land. Epuration took place as completely as in the natural earth. Chloroform was then passed through the column, which at once arrested epuration, and the sewage traversed the column without being purified.

Paralyzation of the infusoria stopped oxidation of the organic matter.

We have eminent German authority for the statement that "there is not a particle of loss of fertilizing matter in a closed conduit having a run of seven miles." There is no indication of decomposition of the sewage of Boston when it first reaches Moon Island. The Royal Commissioners of England, after experiment, report that there is not a river in the kingdom, supposing it to have an average run of one mile per hour, long enough to dispose of ten per cent. of sewage by oxidation.

The system requires close attention, for the pervious tile soon becomes impervious by a coating of grease and filling of spaces with insoluble matter. This was the experience at Gennevilliers which caused the sub-surface distributing drains to be discarded. It is so at the Women's Prison in Sherborn, where this system is employed at an expense of fourteen thousand dollars for five acres.

The system is nothing more or less than a leaching cesspool, which analyses of the effluent water conclusively prove.

Women's Prison System. Parts per 100,000.

	Ammo.	Alb. Ammo.	Chlo.	Residue.
Supply End, ...	.240	.018	9.58	68.5
Flow End, ...	.232	.034	9.22	69.0

Irrigation and Agriculture.

Berlin has two large farms devoted to this object, one of 2,035 acres and another of 1,818. A great many chemical experiments were tried before the adoption of the present system. They proved very expensive and none purified the water, although many clarified it. Finally, after experimenting in irrigation and agriculture on a little field of about eight acres, such favorable results were realized that this system was adopted for the city, the eminent Virchow being one of its principal advocates. At the present time

1,067 acres suffice to purify 15,060,000 gallons per day, the drainage of four-fifths of the city, comprising a population of over 600,000. There is some odor at the opening of the large sewers, but in the fields there is no smell, and the sanitary conditions are all that could be desired. The effluent drain-water of the farms is clear and pure, it being impossible to recognize by chemistry or microscopy any influence of the sewage. The surface systems are open ditches, and below subsoil drains, about five feet deep, for the effluent water. It is constructed solely to get rid of the sewage. Agriculture is a secondary consideration, but at the present time there is every assurance of its being profitable.

Dantzic, with sewage, polluted her harbor at the mouth of the Vistula on the Baltic, and consequently was obliged to adopt other means of disposal. A barren island was selected for irrigation. It had a sandy soil with no vegetation. The island is now in a high state of cultivation, and the sanitary exposition at Brussels awarded an extra premium to the city for its successful farms. Mr. Aird, who has the contract to take care of the sewage, sub-lets the land to peasants at from twenty to thirty dollars per acre. He finds it profitable, and has lately made a similar contract with the city of Breslau. Florence, Milan, and Madrid, have sewage farms, and the Italian government recommends the system to cities of Italy.

On the farm of Edinburg, in Scotland, are located beautiful nurseries for the children of the city. At Lochend the farm produces $200 worth of hay per acre. Sixteen acres at Rugby furnish feed for fifty-four head of cattle, and at Aldershot, Banbury, Bedford, Croydon, Norwood, Warwick and Worthing, the reports in detail show a wonderful production of the land treated in this manner. Leamington, after costly litigation and chemical experiments, contracted with Lord Warwick to take the sewage on his farm. Without levelling the land, it has proved a great success in every point of view, having transformed the poorest parts of the farm into land of great fertility. From eight to nine cuts of Italian rye grass, two feet high, are made each year. Celery, strawberries and currants grow remarkably well. The beef, milk and butter are in great demand and bring the highest prices, while the laborers dwelling on the farm are in the best of health.

The sewage farm at Croydon is surrounded by beautiful villas. There has been but one complaint during the past twelve years, and then as a result of an accident.

Irrigation at Paris.

I should like to reproduce the history of the Gennevilliers farms, as told by the six commissioners appointed by the municipal government of Paris, but must content myself with brief abstracts from a translation I have already published.

Before the execution of the measures conceived by M. Belgrand for the general healthfulness of Paris, the rain-water and the washings of the streets flowed into the Seine, either directly, or by a great number of drains emptying on the quays of each bank the whole length of Paris. This mode of drainage resulted in the immediate and pronounced pollution of the river, which reached the maximum at the point where it leaves the city. The work of Belgrand had for its result the concentration of four-fifths of the drain water in a large sewer opening into the river at Clichy, while the remainder was discharged at St. Denis. At the same time the water for domestic supply was largely increased. In 1860 30,000,000 gallons per day were furnished for this purpose; in 1882 92,000,000 gallons were required each day, or 34,020,000,000 gallons per year. This, with the rain-water which falls on the city, estimated at from 9,576,000,000 to 11,340,000,000 gallons, makes a total of 44,100,000,000 to 45,360,000,000 gallons, which, were it not for evaporation and other loss, should be carried by the sewers. This loss amounts to something like 18,900,000,000 gallons per year, as indicated by gauges in the two sewers, which register 26,208,000,000 gallons (about 42 per cent. disappearing by evaporation). As a result of currents and obstacles in the river, mixing did not take place; and the right bank — the most densely peopled — received on a very long margin the totality of the drain water, depositing all the way organic matter brought in suspension. Protestations from people living along the right bank of the river followed very closely the opening of the two great sewers; and the state government required the city of Paris to seriously consider methods of purifying the sewage before discharging it into the river. The savants, engineers, chemists, traders and agriculturists discussed the subject in all its phases, and to the latter we are indebted for a practical solution of the problem.

Filterage was naturally the first system to be tried. It was soon found that, besides the actual difficulties of filtration on so large a scale, this mode of treatment had the capital vice of leaving in the water soluble organic matter capable of fermentation, and later, chemical agents were resorted to with the object of precipitating the soluble matter, but only incomplete results were obtained, which were slow, costly, and inapplicable on so large a scale.

We now come to the experiment which after fifteen years of study and persevering effort has given a result most complete and satisfactory. Epuration and utilization by agriculture, and filtration by spreading the sewage on permeable land, have accomplished this end. It is based on simple principles, of which the demonstration is now made. All argilo-silicious and permeable soils, sufficiently thick and well-drained, have the property of retaining in their superior layers all the organic matter in suspension and solution contained in drain water spread on the surface of the land. Such soil can receive without being made damp or marshy one inch of water per day, or twenty-six feet per year. It transforms the retained organic matter, rendering it capable of assimilation by plants.

A very large proportion of the water used in irrigation is evaporated either directly or by the plants in vegetation. The residuary water coming from the subsoil drains is of a remarkable purity, and does not suggest, either by aspect or composition, the sewage from which it proceeds.

Trusting in these principles, and fortified by the works of Messrs. De Freycinet, Schloessing, Mariè-Davy and Frankland, the engineers of the municipal service, have, since 1867, pursued studies and made experiments for which, notably since 1872, the council has furnished a large amount of money. These efforts have had as a result the great and actual demonstration at Gennevilliers, which evidence impresses favorably all unprejudiced persons who take the trouble to visit the lands.

After some experimental cultivation at Clichy in 1867 and 1868 the irrigation of the plains of Gennevilliers was begun in 1869 by Messrs. Mille and Durand-Claye. In 1870 and 1872 the territory comprised but a few hectares. It has increased each year, until now over 500 hectares are thus employed (about 1,200 acres, which receive nearly one-fourth the sewage of the city). In the beginning the water distributed was limited to a few thousand cubic metres. In 1872 444,000,000 gallons were used. In 1881 4,685,000,000 gallons were discharged on the land. In May of this year (1881) 684,300,000 gallons — 22,050,000 gallons per day, or 44,100 gallons per hectare per day — these plains absorbed. In 1882, at the time of the report, the distribution reached 34,020,000 gallons per day, or 79,300 gallons per hectare, which represents a sheet of water spread over the surface equal to a little over one inch per day.

Early in the establishment of the Gennevilliers farms an unfortunate accident occurred, which proved very expensive to the city of Paris and greatly retarded the progress of the system both at Paris and throughout the world — for the story, with gross exaggeration, rapidly spread. The difficulty was caused, reports the commission, by the engineers relying too much on the very great permeability of the soil, and not thinking it necessary to subsoil drain the land. An excessive irrigation resulted in overflowing the territory, filling cellars and rendering useless a few gravel quarries. This was sufficient excuse for excessive damages to be claimed of so rich a victim as the city of Paris. Some were compromised, others were resisted in the courts at great expense. In the mean time the surface drains were taken up, having been found unnecessary, and deep subsoil drains for the effluent water were laid, which completely obviated the difficulty; and the community, frightened lest its demands and outcries should cause the withdrawal of the sewage from the fields, united in a petition asking for a contract which should enable them to receive the sewage for twelve years, and, when the paper was signed, erected a monument to commemorate the event.

The efficacy of this system of epuration is manifest, and presents a brilliant proof. The effluent drain water has fewer micro-organisms than the water of the Seine when it enters Paris. It has the purity of spring water coming from the earth. To demonstrate the utility of the system as applied to agriculture has been slow and difficult, and not less laborious than to test the efficacy of the epuration.

The slowness of experiments in agriculture may be understood when we remember that to reach an end we must go through all the phases of vegetation, from the sowing of the seed to the harvest. Under our climate it is a campaign of a year. If we neglect a detail, if we make a mistake at the time of sowing or planting, at the time of ploughing or watering, the harvest may be a failure, and we must begin again. The difficulty was increased by local circumstances. Amongst the cultivators of land in the suburbs of Paris, no one knew the practical working of a sewage farm. One of the persistent workers who has been rewarded by success said recently that it required more than four years to acquire the necessary knowledge. To-day the cultivators are in complete possession of their art, and in the recent horticultural exhibition every one admired the remarkable products, which received honorable distinctions.

In agriculture, successes which would be shown by beautiful samples obtained in the fields of experiment would be objects of curiosity. It is necessary to secure economical results, and these go far beyond the utmost expectations. For the landlord of the soil the rent value of the hectare has increased fivefold, from 90 to 450 francs. For the farmer or cultivator the prosperity has not been less. The net value of vegetable products rose from little or nothing to 4,000 francs per hectare.

In a sanitary point of view the results have not been less satisfactory, and here again it is necessary to observe the facts on the ground. One sees a numerous population, robust and healthy in proportion to its prosperity. Its vigor assures a healthy nutrition equivalent to its works, which is the best hygiene.

As to the effects of irrigation, the same occurs at Gennevilliers which always takes place where irrigation is practised: from the moment it is made frequent, without stagnation, and at regular intervals, a condition which is far from favorable for the development of paludal influences. The determining causes are eliminated; a constant activity is maintained in the vegetable life, which absorbs in its circulation all its own residues and all the organic elements placed within reach. Highly to the honor of the city of Paris be it said that, by the perseverance of its representatives, by the science and devotion of its engineers, the problem of epuration of the residuum of cities and of its utilization by agriculture is absolutely and definitely solved. We have no longer the experiment of Gennevilliers; we have a system permanent and regular for the future.

The population of Gennevilliers has increased by farmers coming to occupy the lands thirty-four per cent. in ten years.

Babut du Marès writes: It has been claimed that prolonged irrigation will produce disease by the presence of bacteria in the sewage. Experience is to the contrary, as illustrated in the sewage farm at Buntzlau, which has been irrigated two and a half centuries, Edinburg two centuries, and China ten centuries without any such results.

SANITATION.

From a sanitary point of view there are no objections and many advantages derived from this system. At Ware, in Hertfordshire, is situated the celebrated "Rye House," close by a sewage farm. The summer house known as "Retainer's Hall" is separated from the farm only by the boards of which it is constructed. The farmer, who spends but a portion of the year at the farm house in the centre of the irrigated field, says the only annoyance he experiences is the increased appetite of his family. At Ruthin, in North Wales, the railroad track alone separates a sewage farm from the station of the North-west Railroad, and the town is not more than 300 or 400 yards from the irrigated meadow. A large volume would be required to collect all the evidence in this direction.

Dr. Frankland, the prince of chemists, wrote in May, 1881: "There are in nature powerful agents for the destruction of disease. It cannot be doubted; otherwise the human race would long ago have been exterminated. The problem is not entirely solved, but experience appears to demonstrate this action on sewage employed in irrigation; for when known to be infected by cholera and typhoid fever in England it has never produced these diseases in the inhabitants living on the sewage farms and consuming the produce."

A system endorsed and advocated by such men as Virchow and Liebig, Pasteur, Schloessing and Mariè-Davy, Frankland and Carpenter possesses a guarantee unquestionable.

TRANSPORTATION.

In constructing a sewerage system, the town or city pays the costs of transportation; for, of necessity, it must be built to discharge somewhere, and ordinarily it would be no more expensive to discharge on neighboring farms than into a river or bay. Many places are obliged to elevate their sewage with pumps before it is finally disposed of. It would be just as cheap to pump it on the land.

A commission appointed some time since by the Parisian government stated that "irrigation is the most economic and efficacious means of conveying directly to plants the fertilizing matter of sewage."

Delivered at a favorable point, no elaborate system is necessary for its utilization. A cemented reservoir, with Akron pipes which will sustain the pressure of two atmospheres, and gates to govern and divert the flow to the open ditches, is all that is necessary. Hose might be substituted for the Akron pipe. On a light sandy soil, subsoil drains for the effluent water are unnecessary. The sewage is best carried in shallow ditches a few inches deep, and elevated slightly above the level of the field. A plough will do the entire construction, making what is known as the donkey-back system, — elevated open ditches, having a fall of about one inch in 1,500 feet, ten feet apart, and sloping banks one inch to the foot on which is the vegetation.

The use should in all cases be intermittent while the crop is growing, that the oxygen of the air may occasionally penetrate the soil, giving it a chance to breathe as it were. But in winter, when vegetation slumbers, it may flow freely over the land, where the fertilizing properties will accumulate without loss at or near the surface. Babut du Marès claims that sewage in freezing eliminates these properties as completely as salt water does salt in the same process, and thus epuration is as perfect in winter as in summer.

The highly productive farms of Holland are entirely submerged during winter. The periodic overflow of the Nile gives to the valley a reputation for natural productiveness unequalled in any other part of the world.

J. Bailey Denton says: "Every day's experience at Merthyr has served to prove that with the most suitable free soil it is hardly possible to overcharge them with liquids."

It nevertheless is desirable there should be provision made by the town or city for storm water by an overflow, or waste, as the soil would otherwise be washed during heavy rains. If there are no stagnant places in the ditches there will be no odor, except where the trunk sewer first emerges from the earth, where there will be some smell of fresh sewage. Repeated experiments in Germany and France have demonstrated that in closed conduits decomposition does not take place, and therefore there is no loss of fertilizing properties. When, in the open ditches oxidation is so rapid, and the deodorizing effects of the earth so powerful, nothing objectionable is observed, — a fact which has probably been noticed by all of you in the common earth-closet.

The sewage should not come in contact with the foliage of the plants. Tape-worm is said to be extremely prevalent in Northern China and caused by the habit of emptying fœcal matter on the leaves of vegetation, and the eggs of this animal are thus taken from one individual to be propagated in another, and other diseases would be liable to a similar mode of transmission.

TEMPERATURE OF SEWAGE.

Our winter climate is often raised as an objection to the employment of sewage in irrigation. The facts do not warrant this assumption, for at Pullman, Ill., epuration takes place as well in winter as in summer. At Dantzic, where the mean winter temperature is about that of our own, where the soil freezes four feet deep, and the Vistula is frozen over from the middle of November to March, the temperature of the sewage at the mouth of the sewer never goes below 37° F. The temperature of sewage is always above the freezing point when underground, and where it comes to the surface it melts the snow and ice so that it finds its way readily into the earth. At times a thin skin of ice forms on the surface of the land underneath which the sewage disappears.

DILUTION OF SEWAGE.

The enormous dilution of sewage with water is used as an argument against its profitable employment, as the land required for so large an amount of water would not be materially benefited by the small proportion of fertilizing material. Analyses of drain water, both in Europe and America, show but trifling variation in composition or relative amount of fertilizing matter. Durand-Claye, addressing the Society of Agriculture of France, said that "34,020 gals. of drain water was about equal to 2,679 lbs. of dunghill, both in nitrogen, phosphoric acid and potash, and that it is practically a liquid manure," and further, that it is desirable and necessary there should be great dilution in order to insure rapid transit; and Dr. Carpenter, the celebrated English scientist, says, "the more dilute the better is the sewage for irrigating purposes." The water alone would be found valuable on much of the soil of Massachusetts. Farmers in Arlington pay the town $150 a year for filtered water employed in their gardens, and many, unable to get sufficient town water, have erected expensive windmills to raise water for this purpose. The alternate soaking and drying renders the soil lighter, more porous and warmer, and consequently will produce earlier crops. The early green patches of grass about springs are familiar illustrations. On the 19th of last April Virchow visited the sewage farms of Edinburg. From an eminence could be seen the line of demarcation separating the two hundred and fifty acres from the surrounding territory. The fresh green verdure of the farm, where the first cutting of grass had already begun, was in striking contrast to the brown fields outside, with nothing in their appearance to indicate the approach of spring. After two hundred years of irrigation, — water-closets being connected with the drains for the last fifty, — there is no pollution of the soil or diminution of the amount of liquid taken up. There is one acre to about one thousand inhabitants. (From Virchow's Archives.)

J. Bailey Denton estimates the loss by evaporation on irrigated lands in England to be equal to one-half of the entire amount used. There the yearly average humidity is between 80 and 86. Here it is about 70. In this respect the meteorological conditions are more favorable here than there, for the more remote the point of saturation the greater the capacity of air to take up moisture.

With water and manure delivered without expense to the farmer, profit ought not to be a matter of question. Five years ago R. W. Peregrine Birch published a little pamphlet bearing the title of "Fifty Instances of Profitable Sewage Utilization," and after a detailed account of as many farms, concludes:

First. That there are upwards of one hundred owners and occupiers of land in Great Britain who use sewage for the sake alone of what they can get out of it by agricultural means.

Second. That of this number more than sixty are tenant farmers, who continue to use it, although they have, annually at least, the option of ceasing to do so.

Third. That of the latter number about five-sixths, and of the total number three-fourths, actually pay money for the use of the sewage, either in the form of out-fall rent, unquestionable increase of land rent, or the price of occasional dressings.

Nearly four thousand acres of sewage land, he says, have been referred to, and these are in the hands of more than a hundred distinct occupiers.

The Paris commission absolutely affirm without equivocation that the Gennevilliers farms are conducted at a great profit, inasmuch as the land where sewage was not applied commanded only a rent value of from 90 to 120 francs, whereas, adjacent irrigated lands were rented at from 350 to 450 francs per hectare, and upon the recommendation of this commission the city has lately purchased 2,500 acres to extend the system of irrigation and enjoy the profit.

The Edinburg farms, in use over 250 years, have for a long time been a source of profit to the city. Lord Warwick, after paying the city of Leamington $2,250 per year for delivering 1,000,000 gallons per day at the highest point of his farm, finds profit in the enterprise, according to his own testimony, and for many years has enjoyed the reputation of managing one of the best-kept farms in the kingdom. Year after year he captured the silver cup, until finally ruled out from competition. Supt. Martin, of the Pullman farm, writes me, that "last year the farm paid over six per cent. on the money invested ($80,000), and this year he hopes to do better." And I am happy to announce that the latest information I have from the farm indicates that he has realized his hopes. The presence of fish in the effluent water of this farm is evidence of the efficacy of the epuration.

The soil does not clog where regular and systematic irrigation is employed. The thin skin of deposit, when dried, shrinks, cracks and breaks up, the organic matter decays and becomes food for vegetation, and thus the soil becomes more light and porous, as is noticed after a rainfall. Buntzlau has irrigated with sewage fifteen hectares for two and a half centuries without diminishing the permeability of the land, or any other deleterious result.

FAVORABLE SOILS.

The most favorable soil for irrigation is a sandy loam underlaid by coarse sand or gravel. This does not require subsoil drainage. Other soils, containing a proportion of clay, will absorb less liquid, but by underdraining will take care of a good amount. Stiff clay soils crack deep when dried after a dose of liquid, and are, therefore, not useful for irrigation.

The sandy wastes of the Great Salt Lake Desert, California and New Mexico, are to-day made fertile by irrigating with fresh, pure water. The practical application of these views, gentlemen, lies in the total and absolute abandonment of that "relic of barbarism," the cesspool, to which may be fairly charged a large proportion of the 10,000 cases of typhoid fever occurring in this State each year. In its place an open or covered sink drain, in which may be poured the slops the family should discharge, without stagnation, in the garden for the benefit of vegetation. The fœcal matter should be deposited in vaults with impervious walls, into which should occasionally be thrown a shovelful of loam or chip dirt, and emptied at least twice each year. During the past summer a plot of ground about fifteen feet square was sufficient to dispose of all the sink water of two families with a lavish use of running water. On this land I raised corn, onions, carrots, parsnips, and a little Italian rye grass, as an experiment. The yield of all was much larger than on adjacent land, and there was an entire absence of effluvia.

In towns the sewage systems should be constructed with the final object of discharging on favorable soil, for the time is fast approaching when this system must be adopted in this country. The laws enacted last winter by our legislature will ultimately compel the withdrawal of sewage from rivers and ponds, as the policy of the State appears against the abandonment of natural water courses for sewerage purposes. In the meantime the State could well afford to demonstrate by experiment what crops are, in our climate, best adapted to irrigation, and how abundantly the soil can be dosed advantageously. With these questions settled there is little doubt but plenty of land would be found in the State to utilize all the sewage. There are in England to-day two hundred cities and towns disposing of sewage by irrigation and agriculture; most of this work has been begun in the past ten years, notwithstanding it costs on an average £10,000 for an act of Parliament authorizing such establishments. The Royal Commissioners recommend a general law by which this expense would be obviated. No other system shows such a growth. If land can be found in England for this purpose, it ought not be difficult to find it here. Our farmers would strive for the privilege of sharing in the advantages when the demonstration was made, as has been the case at Gennevilliers, where the experimental farm of Paris was described as "appearing like an oasis in the desert."

The encouragement of the cultivation of timber, where sewage may be discharged without expensive preparation, would result in great advantages to the State. Within half a mile of Natick, and bordering on Lake Cochituate, are sixty acres of sprout land. It has a geological formation, which could not be improved for the employment of irrigation, and here the sewage of the town and Pegan Brook might be utilized.

Boston is charged with the care of the sewage of the Mystic Valley. She owns five acres of sandy soil, where is located a pumping station, and here, with little expense, the practicability of the system might be demonstrated, and the city and State probably be saved the necessity of constructing a metropolitan sewer to discharge in tide-water, the cost of which has been variously estimated from thirteen to eighty millions of dollars, and which would be, with the experience of London before us, of very doubtful success, to say the least.

The Chairman. I will ask Mr. Edson, of Barnstable, to open the discussion of this important subject.

Mr. Nathan Edson, of Barnstable. We have been very highly entertained and instructed by the lecturer. This question of the disposal of sewage is one of the important questions of our civilization. We dwellers in New England, in passing across the State of Massachusetts, must see abundant evidence of the deterioration of the land. Farms are run out and deserted. Farms are only kept up to a high state of fertility by a large expenditure of money, used in the purchase of manures. At the same time a vast amount of fertilizing material is passing off into the rivers — irretrievably lost to agriculture. We have very little idea of the amount of this enormous loss. Let us stop and estimate it for a moment. We will take the population of this country at fifty millions. Let us see how much is consumed at a single breakfast. We will allow four ounces of meat and four ounces of bread, or its equivalent, to each individual. That is a quarter of a pound of meat for each of the fifty millions; — 12,500,000 pounds of meat for a single breakfast. Put it into bullocks of a thousand pounds; — 12,500 bullocks at one single meal. There would be five barrels of flour for each bullock, or 62,500 barrels of flour at a single meal. The most of that is lost as an element of fertility. We are an extravagant and wasteful nation, but in no thing are we so wasteful as we are in the fertility of our soils. In all our large cities, which consume a great portion of this food, it is passed into rivers or directly into the sea. It is a cause of pollution or is lost forever. In the country it is not much better. We dig our privy vaults in a porous soil, and the liquid contaminates the springs and streams, and a great portion of it passes off into the air.

We farmers in the country cannot control the sewage of cities, but we can control our own sewage by a little forethought. A few cart loads of dry earth deposited somewhere near the house and used freely in the privy vault, in the pig pen, and in the sink drain, will make us twenty loads of strong fertilizer, with a family of eight persons, worth twenty dollars. It is not a great amount. But we have four millions of farmers. Four times twenty are eighty. There are eighty millions of dollars that might be saved to the country. And not only saved once, but twice. It would be saved in keeping up the fertility of the soil and saved in doctor's bills; saving the water and air from contamination.

This can be done. There are very few, however, who do it. I am very glad to have heard this essay, and I hope it will at least set us thinking about this matter. The whole wealth of the country lies in the soil. Our population is increasing at the rate of about three per cent. a year, and we are diminishing the value of the soil about in the same ratio. If we do not devise some plan by which this waste can be prevented, we shall by-and-by be forced to do it.

Col. HENRY W. WILSON of Boston. Mr. Chairman,—The paper is a very creditable performance, and from the speaker's standpoint, and with the purpose he has had in view for many years, having given much attention to such subjects, he has presented, as fully as it could be done by anybody in the time allowed him, a summary of what has been successfully accomplished in this direction. I wish that he had also indicated some of the admitted failures. We oftentimes learn a great deal more by the failures of other men than we do by their successes. Such are the varying conditions in different places, that what proved to be a failure in one case might be a triumphant success elsewhere.

I hardly know where to begin to discuss this question, because it is so extensive, and its ramifications are so interwoven with domestic life. It has its sanitary aspects as well as its economical phases, and they are so intermingled that it is almost impossible to separate them.

As I understand it, this discussion to-day is to be, and ought to be, restricted exclusively to the economical question of the utilization of sewage in agriculture, and consequently, I shall throw aside at once, all those considerations which are concerned with the epuration of sewage, so called; that is, the purification of it to prevent its creating a nuisance.

The very first consideration is to be sure of our facts. You remember the old story of Dr. Franklin. When the savants of Paris wanted to know why, if a fish was put into a pail of water, the water would not weigh any more with the fish than without, and they had discussed the question a good while without discovering a satisfactory reason, they finally referred the problem to the doctor for solution. He heard their statement of the case, and then said: "Gentlemen, suppose you try the experiment, and see whether that is the fact." Now that is the question to which we must direct our attention. Before we attempt to discuss the utilization of this material, we should know whether it is what we want when we get it; if it contains what we need; if we have got a proper place upon which to use it. Furthermore, what will it cost?

In most of the continental cities of Europe, and in other places where epuration of sewage has been attempted, it has been solely because the strong hand of the law has been laid upon those communities, and it has been said to the authorities, "Gentlemen, you must purify your sewage for the preservation of the public health;" and they have done these things, and tried various plans in order to prevent a nuisance. We are coming to that condition of things now in many parts of our land, and our cities and large towns must dispose of this material, for the purpose either of abating or preventing a nuisance. But I warn them against any bright anticipations of being able to realize any profit out of it as a fertilizer. Its treatment must, however, be undertaken. In our small towns it can be utilized, as Dr. Barnes has said. But the sum and substance of human experience has shown, that only by putting this material on the soil in limited quantities, where the well-known action of the soil may operate upon it under favorable circumstances, can its useful fertilizing elements be extracted. Only in that way can the nitrogenous elements be taken from it, which pollute our streams and shores, and produce those favoring conditions which promote disease, and become a public nuisance; and thus we can understand that it may, to a certain extent, be made profitable. But how? In what direction? At what cost? In the first place, we should understand that the sewage of Europe is different in quality from the sewage of this country. That is a point upon which all intelligent examination agrees: that the sewage of Boston and New York, for instance, is entirely different in quality and condition from the sewage of most European cities. The sewage of the ancient world never contained the fœcal matter that flows through the sewers of Boston to-day. The cloaca of Rome was simply a conduit built for the purpose of draining the Pontine marshes. The stream that flowed from it was not the river of gold which writers have pictured as bearing the wealth of Rome to the sea. Soap was an unknown thing in Rome, except as a costly ointment. They used, for lavatory purposes, simply fullers' earth.

There is one element taken out from their sewage which is a very large and important one in our sewers. It is estimated that in Boston fully twenty tons of soap go down the sewers every day, with its potash and grease. That is one element which we have that was not to be found in the sewers of the ancient world. Then we have a large amount of household slops and fœcal matter in our sewage which, in most European cities, they do not have, to any great extent, and in ancient cities it formed no part of sewage. The sewage of this country is charged with it. Everybody has a water-closet to-day, and the deposits, caused by the precipitation of this matter, are creating a nuisance around the wharves and tidal basins of our seaboard cities which was entirely unknown a few years ago. When I commenced my work as a rodman I had frequent occasion to examine the contents of sewers above tide-water, and I did not discover anything offensive in the water flowing in them. There was no trouble then. In 1848 Boston introduced the Cochituate water. For five years water-closets were not so numerous as to be specially enumerated. In 1853, the first enumeration of the water-closets in Boston was taken, and there were then 2,479, or one for every 55 of the population. In 1860 they had increased to 9,864, or one for every 18 of the population. In 1870 they had increased to 25,060, or one for every 10 of the population. In 1880 they had increased to 62,104, or one for every 5.8 of the population. To-day, there are 65,000 water-closets pouring the fœcal discharges of our population into the harbor.

Now, if you are familiar with organic chemistry at all, you know that nitrogen exists in all its various forms in the waste of animal life, and that this matter contains the most active form of nitrogen known. It is all ready for fermentation, and after active fermentation, the nitrogen of excrementitious matter is entirely different from the nitrogen of fats or soap. Consequently, the discharge of those old sewers passed off, in various ways, without creating a very serious nuisance. To-day, the sewage that is distributed about the wharves of our seaboard cities has accumulated to such an extent that it has become an offence which is intolerable. Twenty-one years ago, when I suggested to the authorities of Boston that the time was coming, speedily, when an intercepting sewer must be constructed, to convey the sewage away from our very doors, I was ridiculed. In twelve years the present system of an intercepting sewer was adopted. Then the sewers were scattered in every direction, taking the most direct course to the nearest docks; and by the time they had introduced the new system, there were one hundred and twenty-five egregious nuisances distributed all about the city of Boston. To-day they have united them into one, which discharges into the harbor at Moon Island, and in five years it will have formed the most unmitigated nuisance to be found on this planet.

When we come to examine sewage, it is a very simple looking thing. I have brought some here to show you. There is a bottle filled with the sewage of Boston (showing a bottle of liquid). I don't know how badly it smells; not very bad, I guess. That was taken Sunday afternoon from the pumping station, and a little sediment has collected in it since. But one would not think that such an apparently simple fluid as that could contain so many elements of offence. But when deposited in salt water, the deleterious elements contained in it speedily become serious cause of offence. I suppose an analysis of that water would give five parts in a million of phosphoric acid and about thirty parts in a million of nitrogen. That is all there is in it that is good for anything. That, if put upon the soil, under favorable circumstances, would be a profitable thing to do. But it has cost Boston two cents a thousand gallons for interest on the cost of the works requisite to get it as far as they have carried it, and one cent a thousand gallons additional for maintenance of works and pumping. Consequently, every gallon of that matter that is poured into the harbor costs Boston at the rate of three cents per thousand gallons; in reality, it costs Boston about nine hundred dollars per day to make a nuisance.

Now, where else shall it go? Do you want to put it on your land? Will you treat it by subsidence, chemical precipitation or irrigation? How much territory will you want? Mr. J. Bailey Denton, who has written much on the subject, wanted one acre for every thousand people for sewage irrigation. For several years it was a controverted point among English engineers whether that was the proper proportion or not. Finally, he modified his estimate, and admitted that he might want one acre for every three hundred people. And now it is agreed by the calmest and most unbiased observers, those who like to be on the safe side in their statements and estimates, that it is not proper to calculate on a smaller area than one acre for every hundred of population. That would require four thousand acres for the city of Boston. It must be sandy land, with a gravelly subsoil. Where is such an amount of land of that character to be found within the environs of Boston? That is the problem. I do not know where we can find such a place to go to, and consequently we have to pour it into the sea.

To show what queer notions people get into their heads on this subject, one gentleman came to me who thought he had a panacea for all this evil. Said he: "We can build barges and carry this sewage matter out of the harbor and dump it into the sea, or carry it down to the Cape; then we will not have any trouble from it." I said: "That is a most admirable arrangement. About how large a barge will you have?" He did n't know. "Two or three hundred tons." Said I: "Suppose you should have one of a thousand tons; how much would it cost?" He thought it might cost two or three thousand dollars. Now, a barge of that size would cost twenty thousand dollars. How much sewage is discharged every day? Thirty millions of gallons. What does that represent? One hundred and twelve thousand tons per day. Consequently, one hundred and twelve barges of a thousand tons capacity, costing twenty thousand dollars apiece, would be required to carry that filthy water to the sea. Each barge would cost fifty dollars to handle it, and its load would be worth less than fifteen dollars, estimating the value of fertilizing elements in it. You see that you load the whole problem with such conditions that it falls by its own weight. Another man says: "Why can't we carry it down to Cape Cod? There are thousands of acres down there good for nothing but to shoot sand birds upon." It would cost eight cents for every thousand gallons to get it there, for there must be a pumping station or stations sufficient to give it a head of a foot a mile. To cover an acre of land one foot deep will take three hundred thousand gallons, weighing, in round numbers, one thousand tons. This would be equivalent to one irrigation of that acre. In that thousand tons there would be ten pounds of phosphoric acid, the commercial value of which is twelve cents a pound. Consequently, we would have one dollar and twenty cents' worth of phosphoric acid in the flowage or irrigation of one acre one foot in depth. Then we would have sixty pounds of nitrogen, worth twenty cents per pound, in soluble form. We might get, perhaps, twelve dollars' worth of nitrogen, which, with the phosphoric acid, would give a fertilizing value of not more than thirteen dollars and twenty cents, and it is going to cost twenty-four dollars to get it there. Then it must be distributed at great cost. Better take your money and buy your phosphoric acid and nitrogen in a more compact form at less cost. That is the economical consideration of this question. In Paris, where there is a large area of arable land just across the river, it is a serviceable thing to do. So at Edinburg, some of the sewage has been run upon the adjoining meadows for two hundred years. When this material can be gathered easily and spread upon the land it is a very proper thing to do, but where this is not feasible, it may be well to keep excrementitious matter out of the sewers, although our modern habits will hardly concede that. But somebody says: "Why don't you go around as they do in Holland, or as they do in China, where this material is sold by the inhabitants at so much a year, and gathered from house to house?" Are you ready to go back to that stage of civilization, and keep your night soil for ten cents a year, and gather it at that? You cannot roll back the progress of civilization. You cannot introduce the customs of an Oriental civilization and change the habits of an entire people. I hope never to see the day when the poverty of our people will be so great that men, and much less women, will be obliged to go from house to house to gather the contents of privies in buckets. This is done in Holland and China because it pays; it is not done here because it would not pay. The water-closet of modern times has come to stay. It adds vastly to the comfort and convenience of man, and cannot be abolished. The public must take care of the consequences.

Now, it is clear to my mind, as presented by this paper, that the only solution of this problem for all our interior cities is to make arrangements so that this material can be used, substantially as explained by the speaker, upon land suitable for the purpose; that it is not difficult to find land which is exceedingly well adapted to this mode of cultivation. In Massachusetts there are two causes operating against it. One is, the peculiar nature of our soil, and the other, the irregularity of our climate. Very few people, in trying irrigation, make sufficient allowance for the element of relative temperature as well as moisture. The value of water upon land for irrigation is dependent entirely upon the relative condition of the air with regard to temperature and moisture. Consequently we must consider those aspects. But I do not believe there is any place in Massachusetts, of less than fifty thousand inhabitants, where, with the exercise of intelligence and ordinary skill, this material cannot be utilized, and be utilized well, and in such a way as to conduce to the health and comfort of the community, by the removal of a serious cause of offence, and to turn their sewage, which is much richer in proportion than the sewage of the city of Boston, to a valuable use, instead of allowing it to go to waste, as they do now.

In regard to the dilution of sewage: The city of London consumes twenty-eight gallons of water daily, per capita. Of course, there is no more water running away from the city in the sewers than enters it from the pipes supplying water for domestic and manufacturing purposes. In Boston we consume eighty or ninety gallons per capita. Consequently, the sewage of Boston is diluted three times as much as the sewage of London.

One difficulty in the use of this material on land is this: that we have but a few months in the year when we need irrigation. The farmers of Gennevilliers have this material given to them. It is carried across the river, lifted into the delivery pipes, or canals, and each man has as much as he wants, and when he wants it, without charge. But is there a farmer in New England who could pay the city of Boston eight cents a thousand gallons for this material and make anything out of it? It has been estimated and published by different writers on this subject, that it is worth from one cent to one cent and a half per thousand gallons. Mr. Hope tried it on the Lodge Farm, at Barking Creek, below London, at the outlet of the northern system of London sewage, and he failed for a series of years to make any profit out of it on a farm of several hundred acres; and yet, the sewage cost him nothing. He tried it, and tried it well. I do not think, with the soil that there is there, and the climate they have, that the ordinary farmer can take that sewage and utilize it profitably. But London has got to so dispose of it whether it is profitable or not.

And here comes in another consideration, which has been one of the hindrances to genuine progress in this direction. Engineers have their pet hobbies and their pet schemes, which they each regard as the very highest degree of excellence attainable in that special branch of science. I remember very well that when the new London system was adopted, there was a great deal of discussion about it. I took pains to keep myself informed in regard to it, and I recollect that the engineer in charge of the work, Sir Joseph Bazalgette, insisted that no improvement was possible upon that system. It was asserted by some writers that the sewage matter would be deposited in the lower reaches of the river and create a stupendous nuisance. He said, "No, the tide will carry it down the river and into the ocean, and there will be no trouble." But it turned out that the tide only took it three miles a day. That is, the ebb tide carried it down the stream thirteen miles, and the returning tide brought it back ten; so that the net gain was but three miles a day. The result was that a deposit takes place about and below the outlets at Barking Creek and Crossness which has continued increasing to the present time. Surveys show that deposits have been made to the depth of three, five, and even eight feet, amounting to tens of thousands of cubic yards. This material has been deposited all along the banks of the river, — not only in the shallower parts of the Thames, but in the deeper parts as well, until, as the essayist has told you, it has created such a nuisance that they are at their wits end to know what to do. Grievous complaints are made, that, after an expenditure of twenty millions of dollars, they have still the same old nuisance in an aggravated form.

Another drawback we have had has come from the over-sanguine expectations and assertions of theoretical men. I suppose that one of the greatest failures that ever occurred in England, or in the world, took place in consequence of a letter written by Prof. Liebig, in which he demonstrated, as he supposed, the value of sewage as a fertilizer. He made an estimate of the number of chickens consumed in London every year, the number of heads of cauliflower, the number of bushels of potatoes, and so on, estimating the kind and quantity of food used yearly in London. He determined what the elements in that material were, and, basing his calculation upon that, he estimated the money value of the fertilizing elements of this sewage at ten millions of dollars a year. Thereupon a multitude of adventurers sprang in with their schemes to be the first to secure this nice plum. A company was organized under the name of the Metropolis Sewage and Essex Reclamation Company, if I remember rightly, with a capital of ten millions of dollars. They proposed to take this sewage down to what they call the Maplin Sands, on the seashore, to the north side of the mouth of the river Thames, and, to show the value of this material, they carried several barges full of this sand to the mouth of the sewer, where they made a three-foot layer of sand, and put the sewage upon it. They raised handsome crops of grass; the scheme looked wonderfully promising, and seemed to indicate a large profit. People became interested, the stock was subscribed for, and the company went on with its operations. After a series of experiments, extending over seven or eight years, more or less, at an enormous expense, they finally went to parliament and confessed that they had under-estimated the cost of their works and over-estimated the amount of return; that their labors had ended in disappointment; that they had sunk $1,300,000, and asked practically that they might be disincorporated. That is the record of a company which made the greatest effort hitherto made in England to utilize this material, in order that they might secure a profit. They were after money, and they found, as the Doctor has told you, that the fertilizing elements of sewage cannot be extracted economically from the water. There is no known means by which you can take ammonia from water except by distillation and absorption in the soil. That is demonstrated, and nitrogen in various forms is about all of the fertilizing element there is in sewage.

There is one point which I think is unsatisfactory in regard to what is called the "A B C Process," for the manufacture of guano from sewage. The essayist tells us that they have got a method of making a valuable fertilizer by this means. I know something about that. I have official documents which show conclusively what that fertilizer is worth. The "A B C Process" is called also the Sillar process, and was carried on for a long time near London, by "The Native Guano Company." I have watched its progress with a great deal of interest. They propose by a complicated system to produce a precipitation of the fertilizing elements in sewage, so that they can take them up in a solid form, manipulate them, and make a useful fertilizer for the soil. They occupied public attention about London for a number of years. There was a great deal of secrecy about it, and considerable opposition on the part of other manufacturers. The Drainage Commissioners insisted upon it, as a public demand, that they should show their hand; and finally they were constrained to allow an engineer appointed by the Commissioners to enter their works, and permit the process of manufacture to be conducted in their presence and under their supervision, to ascertain what was done, and they tried a series of tests to see what it was worth. The result was that they made 142 tons of fertilizing material that was solid, tangible, and could be sent away. Then they put that material into the hands of an agricultural chemist to ascertain its value as a commercial fertilizer. They found that it had cost £6 6*s*. per ton. They found that its value in the market, according to the cost of the elements contained in it, was 19*s*. 8*d*. a ton; and they could not find any farmer who would haul it off if they would give it to him. That was the end of the Sillar process of making Native Guano, and that is the difficulty with chemical precipitation of sewage. It cannot be a success as a commercial operation. No experience indicates that the precipitation of this material will give you any relief or any profit. It will only be (as has been indicated by the paper), by such efforts as can be made in the interior towns, in the smaller communities, on the farm, in the little hamlet of a few houses, or in the larger village where this material can be taken out and carried to some of the side-hill farms, that you can get some benefit and profit from it. But in large cities, where it must be carried long distances — twenty or twenty-five miles — and must be pumped to get an elevation of twenty feet, the expense is so great that I do not believe there is any profit in it whatever. There can be no utility in saving two cents at a cost of five; at least, there will be nothing gained to agriculture. Sanitation is another matter.

Dr. Barnes. It is obligatory on the inhabitants of Berlin and Edinburg to connect their water-closets and sewers with the drainage sewers. In the case of those irrigated farms, it is entirely voluntary on the part of the farmers of Gennevilliers to take the sewage or not. They take it to the extent indicated in the paper and use it with the results stated.

In relation to the farms in the vicinity of London, they are situated upon a clay soil, chiefly. It is almost impossible to irrigate such territory, even with the most perfect system of subsoil drainage; it is impossible to get rid of the water, and therefore very many grotesque, unprofitable and ridiculous experiments could be cited, such as those of the companies near London of which Col. Wilson has spoken; yet I think that the only instance in which sewage has been used in this country, at Pullman, and the numerous instances where it has been used with success in Europe, which appear not to be questioned, indicate that it would be profitable here. I think the water itself on the farms in Arlington, Belmont and Bedford would be of great benefit to vegetation.

One of the speakers claims, in consequence of a difference between the sewage of European and American cities, advantages for utilization are possessed by the former which are not enjoyed here. He exhibits a sample of Boston's sewage to show that the enormous dilution renders it very nearly worthless as a fertilizer. On the other hand, he argues that the custom of admitting to our sewers all excrementitious matter gives to the sewage a richness which would require at least one acre to every hundred of inhabitants. This conflict of statement renders it difficult to know if he considers it too rich or too poor in fertilizing properties to be used here. In regard to the sample shown, it should be remembered that the gross appearances (color and sediment) are no guide to the amount of fertilizing properties contained in the bottle. Urine may be nearly transparent, and yet contain more fertilizing properties than an equal bulk of fœcal matter. In reality, there is no material difference in the composition of the sewage.

In Berlin, Dantzic and Breslau, cesspools have been suppressed, and all water-closets are by law compelled to be connected with the sewers.

Durand-Claye, chief engineer of bridges and streets of Paris, after an extensive study of drainage in Germany, writes: "There, it is admitted without question, that municipal healthfulness depends upon three principles. First, the total discharge of water-closets in sewers. Second, the distribution of an abundant supply of water and frequent flushing of drains. Third, the purification of sewage by soil and agriculture." Paris dilutes her sewage equal to that of Boston, by a lavish use of water in washing streets each morning. Edinburg has had water-closets connected with her sewers for fifty years, and there but one acre is employed for every thousand people.

On the other hand, the Rivers Pollution Commission of England, have proved that the exclusion of human fœces has but very slight effect upon the composition of sewage; a conclusion they reached after an examination of the sewage of fifteen towns in which fœces were excluded, and sixteen in which water-closets were used. Great dilution is desirable and necessary for reasons expressed in the main paper. Our soil is capable of disposing of more water than that of England; a rainfall of an inch or more in a few hours makes but little impression on our light soils. We have a much more rapid evaporation because our average atmosphere is dryer. Our State Secretary of this Board reports, since 1853 the rule is drought in Massachusetts, for which he advises the farmers to provide.

The grease in our sewage is easily eliminated after permitting it to accumulate on the surface of a reservoir of deposit.

In conclusion, I venture to affirm that thus far not a single objection has been raised to the employment of irrigation and agriculture for epuration here, which has not been raised and overcome by actual experience in Europe.

Capt. MOORE. I did not intend to speak on this subject at all, and the reason I now do, is that in the paper which has been read, allusion has been made to the sewage of the Reformatory Prison for Women at Sherborn. The sewage from that prison a few years ago ran into a small brook, and after flowing along one or two miles it emptied into Lake Cochituate.

The discharge consisted of the sewage of a prison containing three hundred persons. Upon complaint of the city of Boston the State was put to a great deal of expense to try to purify that sewage. They adopted a plan recommended by Mr. Waring. I am not going to endorse Mr. Waring or his system, but I will tell you what it is. The sewage from that prison is gathered into three or four cisterns or covered basins underground. It filters from one to the other through strainers, and then the thin part, the water, flows off through a twelve-inch pipe which is laid down on the middle of about five or six acres of land. That land was graded, under the direction of Mr. Waring, to a level. This pipe is carried along on the surface of that land, and is covered over with a mound of earth. From this pipe, running upon a level the length of this piece, ten rods, six feet apart, and perhaps ten inches under the surface of the ground, two-inch ordinary drain tile is laid level. This water flows into the large pipe, and from there flows into these small pipes, and out of the small pipes percolates through the soil. Then below that is another system of tiles, which are laid somewhere from thirty to forty feet apart, perhaps thirty feet, and about five feet below the others. They flow into a ditch, where this brook percolates down through, that has planking on the sides and bottom, and that water is carried off, supposed to be purified, into Lake Cochituate.

The Chairman. I have now the pleasure of introducing Prof. D. P. Penhallow, who was connected with the Agricultural College in Japan at its foundation, and is now a professor at McGill College, Montreal.

PLANTS IN THEIR RELATION TO DISEASE.

BY. PROF. D. P. PENHALLOW.

[The manuscript of the lecture was not received in time to be printed.]

The Chairman. If any one has any question to ask Prof. Penhallow there is now an opportunity.

Mr. Phillips. I would like to ask Professor Penhallow how to cure the pear blight.

Prof. Penhallow. We do not pretend to cure it yet, but we hope we have some light upon it. Dr. Goessmann, some time since, found that sulphate of potash was the most effective salt which could be applied. I have submitted trees to treatment involving the use of sulphate of potash as a special fertilizer, and phosphates as a general food for building up the constitution, with a considerable degree of success, which would seem to give us hope that we may be on the right track.

Mr. Ware, of Marblehead. I would like to ask the cause of pear blight, and in what condition is the tree most subject to blight; whether in a state of vigorous growth, which would be induced by high cultivation, or a less vigorous growth, that would naturally be developed when land is in grass, but not under active cultivation?

Prof. Penhallow. Pear blight in its mode of development is so complicated, that we have not yet been able to arrive at a conclusion which would enable us to determine what may be its precise cause. Certain farmers, whose judgment is very good in such matters, have assured me that their trees have been in the best condition when they were growing in grass land; and others have said that that is the worst possible condition in which they could be grown. I have seen trees where the results have been favorable and unfavorable in both conditions, and I have been led to the conclusion that there was some cause at work other than the mere presence or absence of sod. I am inclined to think that the pear blight is a constitutional disease, and the line I am working upon at present is upon the basis of nutrition. I am aware that certain experiments have been made tending to show that the pear blight is developed directly by inoculation; by the direct operation of pathogenic bacteria. I have examined hundreds of pear trees, and I have not yet been able to find, with one exception,— and that we could not operate upon, — a pear tree which would so satisfy the true condition of normal health that we would be willing to submit it to the inoculation system; but some experiments which have been performed abroad seem to indicate that the disease is an infectious one and can be propagated by inoculation from one tree to another. I am inclined to believe, however, in the absence of testimony to the contrary, that the subjects were not in proper condition for inoculation.

Mr. Ware. My observation is that the pear blight comes upon one limb in one year, and perhaps another year upon another limb, but the whole tree is not affected at the same time. That would seem to indicate that the whole tree is not constitutionally affected or diseased, but the disease is local.

Prof Penhallow. That is where a mistake is commonly made. The trouble is that a sufficient number of experiments are not undertaken for the determination of the disease when it appears; and as a matter of fact, I feel very well convinced that the disease has existed in the tree for some time previous to what we generally consider the appearance of the disease as manifested in the blackened limb. In fact, the blackened limb is evidence of the last stage of development. It is proof that the limb has actually died from the disease, and the black color is evidence of decomposition, not that the disease first attacks the tree at that time. By tracing back the blight in the limb, in the trunk, in its various forms, I am well satisfied that it appears often in a more localized form than where it involves the entire branch. For instance, black spots appear frequently upon the trunks of small pear trees, not more than half an inch in diameter. These will spread. I have seen them spread in one season so that they covered the entire trunk, and girdled it. Then we have the ordinary effects of girdling; the tree will die. That is, if the diseased part penetrates into the living part. I have also seen cases where the tree was so vigorous that a new growth of bark was formed; the strength of the tree was sufficient to throw off that dead portion. Then we have what appears to be new bark formed under the dead bark, and so we may have these conditions repeated continually. It is evidence of that character that leads me to believe that the disease is constitutional and exists in the sap long before its appearance in the blighted limb.

QUESTION. Do you consider that there is any better remedy than to remove the tree and replace it with a new one?

Prof. PENHALLOW. Before I decided upon that, I should want to make a strong effort to cure the tree.

QUESTION. What would be your remedy?

Prof. PENHALLOW. I should apply sulphate of potash as a special fertilizer around the roots, in connection with soluble phosphates.

QUESTION. What would be your advice as to the quantity to be applied to a tree five or six years old?

Prof. PENHALLOW. From 100 to 150 pounds to the acre; say three or four pounds to a tree, if the tree is not very badly diseased. If badly diseased, I would apply more.

QUESTION. Don't you suppose there is more than one cause of blight in pear trees?

Prof. PENHALLOW. I dare say; and very probably it is developed by a multiplicity of causes. When we come to lack of nutrition as one of the primary causes, of course we have got to take other things into consideration.

QUESTION. Would not frozen sap have a tendency to produce it?

Prof. PENHALLOW. That might tend to its development.

Mr. ———. I noticed, several years ago, when I had some small branches that were affected by this borer, by cutting them off I escaped any further trouble.

Prof. PENHALLOW. The action of the borer would be more sure of introducing the disease after the decay of the surrounding tissues.

Mr. Williams, of Stockbridge. There is one other point that I believe has not been touched upon in relation to the pear; that is, the liability of some kinds of pears to crack. Has this any connection with the blight, or is there any remedy?

Prof. Penhallow. I am not aware that the cracking of pears has any immediate connection with the blight. It is regarded as produced by the local action of a fungus in the pear itself. I have not been able to associate that with the blight with sufficient exactness to say that there is any particular connection between the two; I am inclined to think that there may not be. We have got much more to discover in regard to pear blight before we come to anything definite; but in the meantime I think we may adopt those measures which seem to be tending in the direction of correct results.

Mr. Williams. Have there been any experiments in relation to the cracking of pears to ascertain whether there is any remedy for that?

Prof. Penhallow. Only the application of local treatment. I am inclined to think that the best remedy you can apply is to cut off the pear. It is a development of the fungus on the pear itself which causes the cracking. If we could take the fruit in an early stage of the development of the fungus, and apply something which would kill the fungus, and not injure the pear materially, we might check the disease.

Mr. Hadwen. Can the professor, or some one, inform us, why the fungus seems to attack certain varieties and others are free from cracking?

Prof. Penhallow. Each parasite seems to have its particular host, and I am inclined to believe that the readiness with which parasites attack depends largely upon the constitutional vigor of the host. I think that the more highly cultivated the plant the more it is open to attacks from parasites and other disorders.

Mr. Hadwen. Then we cannot find a remedy through high cultivation?

Prof. Penhallow. Through high cultivation we may guard against the operations of the parasites. Dr. Goessmann told me, at the time of the Centennial Exhibition, when the French Commissioner visited Amherst and inspected the vineyards there, then suffering from the attacks of the phyloxora, he said the vines were the best he had seen. He found a satisfactory explanation of it when he was told that the vines were fed and the phyloxora were also fed ; so that by an excessive supply of food the vines were given a stimulation which enabled them to successfully resist the effects of the parasite.

Mr. ———. How large is the phyloxora?

Prof. Penhallow. It is about the size, if I remember correctly, of the green aphis which lives on the rosebush.

Question. I would like to ask the professor if the fungus mould that is found upon the grape is not the same which causes the cracking in pears? I find, especially upon grapes under glass, that the fruit will crack very much as the pear cracks. We can cure that with sulphur, where we can control the air under glass. I find the same cracking upon my Flemish Beauty pears that I find upon the grape. I would use sulphur if I saw the same cracking upon my grapes, but the pear being out of doors I cannot control the fumes of the sulphur so as to make them effective.

Prof. Penhallow. I do not think it is the same fungus. I think the action of the fungus upon the fruit might be likely to cause the same result, although it might not be the same fungus.

Mr. ———. I have had some trouble with the cracking of the bark of apple trees and some of my trees are dead.

Prof. Penhallow. That is the same blight to which I referred as occurring in the orchard of Fameuse apples in Montreal, where twenty-three per cent. of the trees were involved in the same season. In that particular case, the condition of the soil seemed to be one of the principal causes at work. The subsoil was a very compact clay and the soil above was very thin, and there was no natural drainage ; and from the distribution of the disease in conformity with the character of the soil, it seemed to me very evident that that was one of the principal causes at work. It may be possible that something of the same kind may be operating here, although other causes may be at work.

Question. Is there any better management for an apple orchard than to keep it in grass and top-dress the grass every spring; if not the whole ground, at least as far as the limbs project?

Prof. **Penhallow.** On general principles, I should say, keep the grass off a certain distance from the tree. It strikes me a tree needs the same cultivation, the same harrowing and the same manure, that you would give other crops.

Mr. **Bowditch.** Would you keep the grass as far away as the roots are feeding?

Prof. **Penhallow.** Very nearly to the extent of the limbs. I should adopt the practice myself of always cultivating orchards.

Mr. **Hadwen.** We cannot lay down any rule that seems to be adapted to all conditions under which trees are grown, but each man for himself must determine as well as he can whether he shall top-dress or whether he shall resort to cultivating the entire orchard. I have seen very good results under both conditions, and which is the best I am not able to say. I know that good fruit can be grown where the land under trees is top-dressed and still in grass, and I know that good fruit can be grown under constant cultivation. Consequently it is for each man to determine which course he will pursue. But there is one reliable course, and that is, to have the tree always well enriched. Be sure to do that and the matter of cultivation is of less consequence than is generally supposed.

In relation to the pear blight, I am very sorry to hear that science has not discovered, apparently, any cause, or any remedy. I feel that we ought to have discovered before this late day a cause and a remedy, and I feel disappointed to think that we have not yet found the cause of the pear blight nor a real remedy. It is now some fifty years since I first saw the pear blight. I attributed it then to high cultivation, and I do to-day, in a measure, attribute the cause of the pear blight to high cultivation, which induces a strong, and you might say excessive, growth. I know that the pear blight is more liable to appear in highly cultivated lands than it is under ordinary circumstances in grass land, and still I do not know the real cause. Some people say it is caused by the extreme heat and extreme cold acting on the tender tissues and cells of the wood. That would seem to me to be the apparent cause often. Sometimes I see it on the south side of a tree, where the extreme heat of the sun's rays would be brought to bear, and sometimes I see it on the north side of a tree, where the tree is subjected to extreme cold and extreme changes of temperature between day and night. It does seem to me that by some cause, whether of heat or cold, the cells of the wood have become ruptured, and thus the free flow of the sap obstructed, which causes this blight.

Now for the remedy. We see the blight after it is established; we do not discover it until the leaves begin to turn black, and then, if we cut around the bark of the tree, we find that the trouble is on the inside, that the flow of the sap is obstructed, and consequently the limb dies. The best course to pursue is to remove the limb immediately, and when it is removed, it has precisely the appearance that a limb will have if you cut it off and put it into your stove oven and bring it to a pretty high degree of temperature. You may call it fungus or you may call it anything else, still we are dealing with something mysterious; but I do believe that very high cultivation in a pear orchard is conducive to pear blight. I know that rows of small trees in a nursery, in rich spots, where the wash comes down from the surrounding land, are more liable to blight than they are on soil which is not so rich.

Adjourned to evening.

Evening Session.

The Board met at seven and a half o'clock, Mr. Wheeler in the chair, who introduced the lecturer of the evening, Hon. James S. Grinnell, of Greenfield, as follows: —

You will have the pleasure of listening this evening to one of the only two surviving members of the Board of Agriculture at the date of its organization, some thirty-two years since, who will tell you something of the hindrances to successful farming. I have the pleasure of introducing the Hon. James S. Grinnell, of Greenfield.

HINDRANCES TO SUCCESSFUL FARMING.

BY HON. JAMES S. GRINNELL.

The question, "Is farming in Massachusetts profitable"? is constantly asked, and usually answered with promptness and decision, either in the affirmative or the negative; that it does or does not, according to the personal experience or the immediate observation of the respondent.

When the answer is in the negative, and we are assured that it does not pay to farm in New England, I believe that there is some incapacity, or at least ineptitude, in the individual, or perhaps extraneous circumstances quite foreign to a proper start in that occupation — or, indeed, in any other — and probably outside his control. Whether a farmer considers himself successful depends very much on the construction of language.

No one who sees a farm improving every year, by added or repaired and painted buildings, new fences on outside lines and interior ones removed, lands drained, trees planted, crops of all kinds increased in quality and quantity, sown, planted, cultivated and harvested by new and convenient machinery, the stock of all kinds improved by grading up and by thoroughbreds, would hesitate to say that the owner of such a farm was making it pay. It pays not only in the enhanced value of the property for use, for a sale if it should ever be necessary or desirable, or for his widow and children to whom it must in the course of nature inevitably come. Farmers are naturally secretive as to everything they own which is not exposed to the full glare of their neighbors and the hated assessors, and many a one thinks he is making it pay, if, continuing in the way of his father and grandfather, patching the old, tumble-down, comfortless barn and sheds, covering but not half sheltering his unimproved cattle and sheep, planting and harvesting as they did, with no positive grasp on the improvements of the times and the advance of science, by the severest of labor and a continual denial to himself and family of comforts, and even what others would call necessities, he saves, little by little, enough to deposit in the savings bank a few hundred dollars, drawing a paltry four per cent., to leave as a bone of contention among his children, who have grown up to hate the farm, and who seek at the earliest day the opportunity to squander the hard-earned accumulation of an overthrifty and niggardly father.

Successful farming must depend very much on the skill, industry, judgment and good habits of the man himself, and his attention to the subjects here presented. To farm well, one must farm intelligently, and his measure of success will be accordingly. The difficulties in the way of farming well are not few nor small: difference in climate, even in New England; locality, soil and subsoil; skill enough to select one from the various breeds of cattle for the dairy or the shambles; how to raise them and how best to fatten them; whether to keep sheep or cattle, horses or hogs; whether to practise mixed farming, or to take and keep to a specialty; how to prepare compost, and to use manures and special fertilizers judiciously; a wise selection of crops most profitable in each locality; and a proper rotation of crops, skill in fitting the ground, getting in the seeds, and cultivating and harvesting the crops, — these, unwisely judged and carelessly practised, are all more or less hindrances to successful farming, to be overcome by labor, study and experience. So is every act or non-act of mismanagement, every accident, every item of deterioration, loss or waste, a part of the subject before us.

Success or failure may result either from the exclusion or permission of these constantly recurring wastes on the farm.

Whatever tends to direct and stimulate the industry, whatever spreads prosperity over our fields, whatever carries happiness to the home and content to the people, tends more than anything else to lay the foundations of our Republic deep and strong, and to give the assurance of immortality to our liberties. The errors and deficiencies of our practical agriculture may be referred in a general way to a too limited view among our farmers, and the want of system in their management. These errors and deficiencies which are hindrances to successful farming are not such as require any extent of capital to rectify. All that will be requisite is more attention to both scientific and business principles, more care to practise what they know they should do, and their industry better directed. It is not by great and splendid particular improvements, that the interests of farmers here are best subserved, but by a general and gradual amelioration. Most is done for agriculture when every farmer is incited to small attentions and incidental improvements. Such as proceed, for instance, from the constant application of a few plain and common principles, as, that in farming nothing should be lost and nothing be neglected; that everything should be done in its proper time, and in a thorough manner; everything put in its proper place; everything executed by its proper instrument, and that instrument the best, whether manual, animal or mechanical.

These attentions, when viewed in their individual effect, seem small, but they are great in the aggregate and make or mar success in farming.

The judicious management and cultivation of a farm requires a combined and practical exercise by the farmer of all the knowledge and skill necessary for the cultivation of the articles separately that are produced on the farm. It is obviously a different science from any other, more complex, more difficult to learn, requiring judgment, experience and observation to carry it into successful practice.

Next to an individual's own experience is a true and particular account by others of a judicious and skilful cultivation and management of farms like his own, where the expense for labor, market for crops and habits of living are nearly the same, if he can have their methods and practice fully communicated to him. There is no doubt that under proper conditions, such as would justify attempts at success in any other occupations in life, the rewards of agricultural labor in Massachusetts are ample, in that an industrious, prudent man, with a fair start, — which means free from debt and with health, — may not only obtain by skilful and careful farming a comfortable subsistence, living well, practising a proper and liberal hospitality, rear and educate his children, always having a good home, and something more than mere necessities of life, and constantly adding something to the improvement and value of his farm and buildings as a most safe and permanent investment. The foundation of national wealth is everywhere admitted to be agriculture; it creates matter and gathers its productions without injury or diminution from the exhaustless resources of the air and the earth, and therefore every agricultural production is a direct creation of so much additional matter.

But this, however, is not all. It is not, as in manufacturing, the mere using up or transforming of raw material; but, under good cultivation, the soil itself is put in a condition to become more productive, and the land itself is raised in value in proportion to the increased income which can be obtained from it. A farmer of bad habits, indolent or intemperate, or thriftless from natural or acquired incapacity for active, intelligent work, has no more right to expect success in farming than he would in any other business in life which requires even less of judgment, sagacity and untiring vigilance.

It is said that there are three occupations in life which every man considers himself competent to undertake, — to keep a hotel, to edit a newspaper, and to carry on a farm. The last of these is the last to be attempted, for it is a laborious occupation and combined with great impediments. Starting with the postulate that the profession of agriculture is of prime importance, as being the support of all other trades, occupations and professions, how earnestly should the farmer labor to bring it and himself worthy of the high vocation to which he is called.

Has he generally done this or anything like it? Does he, although engaged in what is confessedly the most important as it is the most widespread occupation, prepare himself for its pursuit, with a care at all to be compared with its magnitude, or to that bestowed by those following any other branch of legitimate business? Does he, like the professional man, fit himself by a course of study and examination of principles and precedents? Like the manufacturer, does he calculate carefully the first cost of the raw material, the exact expenditure of time and labor, thereby ascertaining the cost and so regulating the market? Or does he proceed with that method, that directness of purpose, that certainty of accomplishing certain results, which make the mechanic successful and prosperous?

With the negative which rises in response to these questions, we are perhaps told that all these things are not practicable if possible. It is true that there are certain conditions and elements which are beyond our control; the soil, the climate, sunshine or shade, heat and cold, dryness or moisture cannot be much affected by our efforts; but under that gracious guarantee that seed-time and harvest shall not fail, do we strive to attain, as much as in us lies to attain, a high degree of exactness or perfection in our profession of farming.

Granted that our climate is cold; that our land does not spontaneously produce the food that nurtures nor the garments that cover us; that our soil, naturally unfertile, is worn and exhausted; that our houses and barns, many of them, are old, cold and comfortless; and that our means for repairs and improvements are limited. With all these odds against us do we yet accomplish all we might to improve ourselves and our condition? Do we not find at the very outset a leading cause of hindrance to successful farming in our want of education, of method and system in managing the farm so as to know the cost and profit of each crop, beast, and branch of production, and of every permanent improvement made? There is generally among farmers an entire lack of accuracy in the details of their business, which of course renders any statement of experiments or results uncertain.

For instance, in an attempt to estimate the cost and value of his corn crop, a farmer, calling a piece of land two acres (it may be one and three-quarters or two and one-eighth), hauls upon it so many loads of manure, not knowing whether his cart holds twenty-five or thirty bushels; this he ploughs or harrows in, and plants a proper amount of corn, about three and a half feet each way; he cultivates and hoes as usual, but not keeping any memoranda is unable to say exactly how much labor was bestowed on the piece, having forgotten at the end of the season whether his men worked whole days or only parts at that time.

When the crop is nearly ready to harvest, with a neighbor he measures off a square rod, as nearly as they can, for an average; the corn is picked, shelled and laid on the garret floor for a week, till he calls it dry (though from that time till it is merchantable it will shrink fifteen per cent.), measured up, and the product of the whole field calculated from it. Then, with the assistance of the boys, he estimates as near as he can the amount of labor expended, and so makes to the committee on grain crops a statement of a very large crop at a very small cost, and this is called an experiment and claims a premium.

This occurs every year in almost every society in the Commonwealth, and is a fair illustration, in the lack of accuracy and method, of one of the hindrances to successful farming. Of how little value is such an experiment; and yet is it not common? Is it not a fair specimen of the opinions of farmers generally, even of their own crops? How few there are who can state with any accuracy the actual cost of any animal or crop, the value of their milk, the quantity required to make a pound of butter, the value of the skimmed milk for calves or pigs, the comparative, much less the positive, value of different grains, roots or fodder for milk and flesh separately, or together. Does it seem an undeniable proposition that one knowing these facts accurately or approximately, in his experiments and tests, must, other things being equal, farm more successfully than one who, without special attention, pursues the course his father took, or varies from it only on some uncertain guess?

It would greatly tend to successful farming if a farmer, or some one in his family, would keep memoranda, or a brief diary of the transactions on the farm, by which to compare the operations in successive years, as to times, seasons, cost and value of animals, crops and other productions.

It seems to me that more attention should be paid to farm book-keeping as a branch of education, and I know of no reason why it should not be taught in the common schools of the country.

The importance of this subject to the farmer cannot be overstated, and should not be overlooked. Farmers cannot be too strongly urged to keep exact and faithful accounts with their farms, their animals, and with every crop which they raise; it would immensely assist in the improvement of their farms, by enabling them to decide intelligently how and what to cultivate, the times when they had planted and harvested, and the actual cost and real profit of every crop, animal or product they have raised, and would go a long way toward relieving a very material hindrance to successful farming. In these days of progress and rapid inter-communication, no farmer can be really successful who does not improve his mind, sharpen his intelligence, and keep himself abreast of the times by reading one or more of the excellently managed agricultural papers; in any one of which, though they may differ, "as one star differs from another in glory," he can always find, with the full reports of markets and crops, some useful suggestions in the various essays, letters from other farmers, and perhaps editorials.

What Hamlet says of the players may not unaptly be said of the papers of the day: "They are the abstract and brief chronicles of the times. After your death you were better have a bad epitaph than their ill report while you live." The farmer who entirely neglects these sources of instruction, and those other springs of agricultural education, our valuable State and society reports, to say nothing of the various books on different farm topics, never knows the condition of the market, the crop or stock reports, the names nor uses of the most improved implements and machines, the character and qualities of animals, trees or seeds, and the advanced experiments and tests of all these things by other farmers and the experiment stations, and who keeps himself ignorant of the principles of agricultural chemistry, now deemed so essential to the intelligent management of a farm, has upon his neck a heavy yoke of hindrance to successful farming.

Debt. — Doubtless, one of the most oppressive and discouraging elements covered by the title of this paper is debt. I mean specially the debt contracted in the purchase or the taking of the farm. Many a young man, who has by diligence and prudence accumulated, as a farm laborer or otherwise, a few hundred dollars, fond of the occupation of farming, regarding it as a most honorable and independent way of obtaining a home and an honest living, and perhaps stimulated by the example of other prosperous farmers, unknowing the circumstances of their beginnings or their means, buys a farm at a cost much exceeding his cash resources, and gives a note and mortgage for the remainder, assuming at once a load of interest money, which clings about his neck like "the old man of the mountain" in the Eastern story, never to be shaken off.

How often have we seen a young man with a laudable ambition, but beyond his means, taking his father's farm, — the old homestead endeared to him by every tie of family, birth-place, home, and boyhood's life and pleasures,—probably a good deal run down; perhaps already encumbered with a mortgage, or with brothers or sisters to pay off or support; and often with other encumbrances and expenses, manfully struggling for years, never able to keep quite up but every year falling a little behind, only occasionally cheered by the sale of a tract of land or cutting off an ancestral wood lot. In both these cases the superadded common afflictions of life; the failing health of an ambitious, overworked wife; sickness in the family; a disastrous season; loss of animals and crops; these, all or in part, often breaking the spirit of the man, change his whole nature, making him morose, petulant and stingy in the house, and mean and grasping without; and he is often tempted to curse the day when he left the careless, aimless life of a hired man, and with bright anticipations of a happy future not to be realized, gradually enveloped himself in the gloom of these hindrances to successful farming.

Cultivating too much land. — One item in our subject is the very common attempt of farmers to cultivate more land than they can thoroughly work. The great secret of European agriculture is stated to be, much labor on comparatively little land. Now the tendency of Massachusetts husbandry, from the first settlement of the country, has been little labor on much land; and it is not wonderful that success should be uncertain when our conduct is in direct violation of the principle on which success depends.

There is a natural desire in every farmer's heart, — only controlled by want of means or an unusually strong will and sound judgment, — to own all the land which joins him; and there is really no more unfortunate condition for a farmer to be in than to be "land poor;" to hold the possession of more arable land than he can do justice to, and make profitable in thorough tilling. Of wood land and pastures hereafter.

It is a great hindrance to successful farming to partially cultivate twice as much land as one can manure and work thoroughly. It needs no superior gift, as that of prophecy, nor a column of figures to prove that if with a given amount of fertilizer we can on one acre raise a crop equal to one from the same amount distributed over five acres, we certainly save in time, labor and travel; and this same acre, when heavily manured, will continue to yield large crops of grass for years, while we are going on with others, improving in the same way. This is, in my opinion, the only course that really justifies tobacco raising in this State; a piece of good land, after the heavy manuring and clean cultivation it has received for two years, will produce a great crop of wheat, and a paying hay crop for four or more years. A young farmer at one of our institutes not long ago said, that when a boy, his father, before leaving home for a few days, told him and his brother to cart out a certain quantity of manure from the yard on a lot of about an acre and a quarter. The boys, obeying orders, and with no discretion of their own, went to work with a will, cleared the yard and spread the manure on the field, rather thick, as they thought, and altogether so to the disgusted father on his return, finding seventy-five ox-cart loads of manure spread on his acre and a quarter. But time tardily justified the boys; for on that piece of land, for twelve successive years, grew more grass than on any field of its size on the farm.

Mr. Lilly, of Florence, near Northampton, has become famous for his crop of hay, of which, from his meadow of twelve acres, he cut in two crops seventy-six tons. He has underdrained his lot, and from a capital bed of muck he makes, with some stable manure, wood ashes, coal ashes, fish, and everything that can be utilized, great piles of compost, which he applies at the rate of fifty loads to the acre.

A year ago this fall, after mowing two crops, he turned it all over and seeded with herdsgrass, cutting, last July, three tons to the acre by actual weight, and two tons at the second cutting. This is a good illustration of what may be done by concentrating efforts on a limited space, rather than by diffusing them over a broad extent of territory, where they make but slight impression. The average of hay throughout the State is but little over a ton to the acre, and thousands of acres are mowed which do not yield half a ton to the acre; four entire counties show less than a ton to the acre; and of all the towns in this Commonwealth, one hundred and sixty-four reported in 1875 less than a ton to the acre; 668,183 acres produced only 671,130 tons of hay at both cuttings.*

Now, if every farmer had mowed only one-third as much land as he did, and had that third in as good condition as Mr. Lilly's, he would have had just double the hay he did cut, saving, in the labor of going over so much territory in gathering and storing his hay, enough to pay largely toward the expense of well-manuring his ground. If each farmer in the State could have added one-half ton to each acre, it would, at the going price of 1875, have amounted to over five millions of dollars. The average farmer cuts 12½ pounds to the square rod; Mr. Lilly cuts seventy-five pounds. Now make a very great allowance for the difference in the cost of preparation for his crop and that of what an ordinary farmer might do, and see how much is lost by ruinously attempting to cultivate too much land without the means to support it.

Take the corn crop as another illustration of the same mistake in half cultivating too much land.

The average of the corn crop throughout the State was only 35¾ bushels, to wit: —

Barnstable $27\frac{8}{10}$	to the acre.	Bristol $36\frac{8}{10}$	to the acre.
Berkshire $34\frac{4}{10}$	" " "	Dukes $27\frac{4}{10}$	" " "
Essex $41\frac{8}{10}$	" " "	Franklin $35\frac{6}{10}$	" " "
Hampden $27\frac{5}{10}$	" " "	Hampshire $31\frac{8}{10}$	" " "
Middlesex $42\frac{5}{10}$	" " "	Nantucket 36	" " "
Norfolk $38\frac{8}{10}$	" " "	Plymouth $33\frac{5}{10}$	" " "
Suffolk 30	" " "	Worcester $43\frac{8}{10}$	" " "

Now, within ten years past, from every one of those counties have been published reports by the Secretary of our Board, giving individual cases where from seventy-seven to one hundred bushels of corn had been raised with thorough cultivation and with from twenty-five to fifty dollars' worth of manure and special fertilizers to the acre. If every farm had raised only fifty bushels to the acre, considerably less than the lowest of these trial crops, we should have had about a million and a half dollars added to the value of the corn crop for that year. If a farmer will plough up a piece of good but run-out grass land, put on twenty-five loads of manure, and say eight dollars' worth of some superphosphate to start the crop, till the ground thoroughly by often running the cultivator through it, and dispense with the labor of hand hoeing, he can, as others have done, harvest seventy-five bushels of corn to the acre, more than twice what he would get by scattering his manure over two acres, and half cultivating it with double the labor; he would get more than twice the average of the corn per acre as grown in the State, and at a cost of about thirty cents per bushel. Half a dozen farmers proved this in the Franklin County report for 1880.

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* I am obliged to refer to our State Census of nine years ago, as the Federal Census of 1880 does not afford the means of comparison.

If it were worth the time, an examination of every crop grown would show beyond a doubt that throughout the State we pretend to cultivate about twice the land we should to obtain the crops we do.

Pastures. — A great loss to farmers and a consequent hindrance to successful farming, is to be found in the neglect or unwise treatment of pasture lands. Of these there are in the Commonwealth 1,425,125 acres, valued at $17.41 per acre, amounting to $32,141,620, the interest on which at five per cent. is $1,507,081. A fair calculation of the stock as given by the census, pastured at present prices, would show just about that amount.

There are thousands of acres pastured that should be allowed to grow up to wood, to supply at some time the never ceasing draft made by our farmers on their woodlands, and thousands now mown that should be turned into pasture, the best evidence of which is the fact previously stated, that many towns yield less than the average of a ton of hay to the acre.

The best farmers say that it is not profitable to mow lands that yield less than a ton to the acre; when it falls below that, the land should be re-seeded, tilled or turned into pasture. The land usually appropriated to grazing purposes has been that which, from its location or its soil, or from the combined causes, is considered the least available for cultivation. Hilly ground, difficult to work, swamps not easily drained, and soils encumbered with rocks, comprise a large portion of the permanent pastures of New England; beside this, many farmers have been in the habit of cultivating their smoother land as long as it would bear a remunerating crop, applying as little manure as would possibly serve, and then laying it down to grass, under rye, oats or barley, so as to get the last ounce of nutriment from the soil. This having been pretty thoroughly accomplished, a crop or two of hay is taken from it, and the land is then abandoned in an exhausted condition for a number of years to pasture, and from land thus treated cattle are expected to derive their support for four or five months; they go on it in lean condition in May, and come from it in November as poor as they went out. How to increase the productiveness of these pastures so that they shall not only hold their own, but carry more stock, is the question.

In a pasture there is a constant tendency to deterioration from the increasing growth of bushes, weeds and foul stuff, that deform the land and destroy the feed. The best lands are subject to these evils, and there they will make the greatest encroachments. The first step should be to attack the bushes, briers, sweet ferns, brakes and all sorts of worthless growth with the brush-scythe and bog-hoe or mattock. These pests, we hardly need to say, destroy the nutritious qualities of the grasses; they shade and sour the feed and exhaust the land. Coarse herbage will gradually displace the finer and more nutritive kinds.

The farmer has, therefore, a constant struggle against this natural law of vegetation unless he wishes his land to return to its primal condition. The work of extermination is to be continued annually till the work is finished; after a few years these pests will disappear. But this is not enough; some further means for improving must be applied, about which a diversity of opinion and practice exists. Now I believe that generally through the Commonwealth ploughing and seeding pasture lands would be impracticable and injudicious; impracticable, because the best pasture lands would, to a large extent, be unassailable by the plough, and injudicious, because old pastures, if well kept, are reckoned decidedly more nutritious, more fattening, more permanent, and as producing what is called sweeter feed. Top-dressing with manure is generally out of the question; there is none to spare from the mowing and tillage land, and the expense of hauling it out into the pasture land, even if there were a sufficiency, would be impracticable. Gypsum or plaster of paris, at the rate of two hundred pounds to the acre, or wood ashes, or the two combined, make the best and cheapest top-dressing for pastures. It is said that scratching a pasture with a sharp-toothed harrow and sprinkling grass seed produces good results. If a pasture is to be re-seeded, either by ploughing or harrowing, there is nothing like orchard grass to put in, if the land is strong or reasonably moist. It is perennial, comes the earliest of any grass, and is green the longest; cattle will turn to it early in the spring and feed on it till late in the fall.

One of the best-educated farmers in Franklin County, who made a reputation far beyond the limits of the county, was for years in the habit, not only of cutting the brush and picking off the stones, but of knocking to pieces and scattering the droppings of the cattle, at any time when it was dry enough, and consequently had a great supply of the best feed, and raised the best steers in the county.

Over-stocking a pasture is poor farming and should never be allowed, and so it is not considered good policy to pasture on the same land horses, cattle and sheep; but a large and most successful breeder of fine-woolled sheep in Northern Berkshire told me this fall that in a large pasture he allowed fifty or sixty Spanish merinoes to feed with his herd of dairy cows with no detriment to either.

There is no doubt that grazing sheep on pasture land greatly improves it, and would be largely practised but for the everlasting curse of dogs. I cannot so well present this matter as in the words of one of the most intelligent and earnest of sheep growers in this State twenty-five years ago: "We have constantly had under our eye a hundred-acre lot, upon which, a few years ago, cattle could not live, that now maintains in good condition a large flock of sheep, and the improvement of this pasture has been so great that a dozen head of cattle feed and do well upon it, beside the sheep. The reasons for this are obvious to any one who has observed the habits of sheep. They are more indiscriminate feeders than cattle ; they nip the shoots of almost every shrub as well as weed, extirpating many kinds in the course of two or three years, and in this way they make room for such grasses to grow as have been shaded out or displaced.

"This, however, is only one of the many advantages which sheep bestow upon pastures when they are impoverished. They scatter their manure in the way to produce the largest benefits ; beside which it possesses in the highest degree the requisites for restoring to the land the phosphates which it loses by long depasturing with cattle. The manure, too, of the sheep suffers no waste, being in a highly concentrated form, and at the same time it is minutely divided and evenly distributed over the surface of the ground."

Another wrong which farmers are apt to do to their pasture lands is turning in more stock than the pasture will carry well. A good pasture is desirable and valuable, and there is always a temptation to crowd more beasts into the grazing grounds than can thrive as they should. Beside their own animals, farmers are often induced to take those of other people, who are always willing to pay a good price for a run in good feed. This is very well in the spring, when the feed is flush ; but the consequence is that when a dry time comes, and it always does come, feed is short, gnawed into the ground, the cattle get thin, and the pasture is permanently injured,—the grass roots are exposed first to the drying up of a burning sun and again unprotected against frosts of extreme severity in winter.

The consequence of this is, that the finer grasses are killed out and coarse herbage is likely to usurp their place. In this connection I may say that it is not considered good husbandry to feed cattle on the mowing land in the fall ; poaching up the ground by the feet of the cattle, and exposing the grass roots to the winter's freezing are sufficient reasons for this.

Woodland.—The unwise treatment of woodland is a very important part of our subject, and under the title of forestry occupies much attention in the minds of the people, in the census returns and in legislative debate. The term forestry is a broad one, and the very word forest conveys to our minds the idea of a more extensive growth of trees, and of a larger size, than that covered by the term woodland, commonly used in this part of the country. Indeed, the dictionary definition of forest is given as "a large tract of land covered with wood of native or original growth, that has never been cleared nor cultivated, and differs from woodland mostly in extent."

The unwise treatment consists in careless cutting of wood and timber, the lack of effort under the law to prevent forest fires, and the neglect to preserve what we have and to provide for the future. The great and reckless destruction of the wood and timber in various parts of the country by clearing and by fires, must soon induce some positive and prohibitory action in the Federal and in State Legislatures.

Our own Legislature, in 1882, in response to numerous and very urgent petitions and appeals from people in various parts of the State, especially at the east, for protecton against forest fires, passed an act adding to the statutes already existing, going as far in stringency as was thought prudent, to protect owners of woodlands against loss by fire, a thorough enforcement of which by the owners of woodland would go far to prevent the destruction of their property.

A few items show the immensity of some parts of the lumber business, as interesting to us, proportionately, as to any part of the country. In the country at large, it takes about thirty years from the growth of about 75,000 acres of land to furnish annually the ties for the railways running in the United States. The number of ties required for a mile is about 2,500, and on that average there are about 250,000,000 in use through the country at this time; these are constantly decaying, their average life continuing but from five to seven years, and consequently we must have from thirty to fifty million new ties every year to maintain our present railways in constant use, beside the new ones continually projected and constructed. The number of ties on an acre of land would of course vary with the location and the character of the soil, but at 500 to the acre, not too large an estimate, we should need to cut over from 75,000 to 80,000 acres of land each year to meet this demand. Telegraph poles represent 800,000 trees, and their annual repair about 300,000 more; and 1,500,000 cords of wood are used to burn the bricks and tiles annually made in the United States.

In our State census "woodland" includes all territory covered with uncultivated trees. Of this, the census of 1880 gives 1,230,768 acres; 50,000 acres more than we had in 1860, and increasing yearly. Figures show that in 1875 we had grown careful, cutting over 250,000 cords of wood less than we did in 1855. There is a well-grounded belief among people quite competent to judge, that the cutting of wood and timber is better regulated, and that there is more wood growing in Massachusetts now than there was forty years ago. This results partly from the fact that thousands of acres, which formerly pastured thousands of sheep, have been given up to the growth of wood, the destruction and terror by dogs having destroyed sheep husbandry.

The census, too, shows our woodland increasing; for while there has been great destruction by cutting and by fires, especially in the eastern part of the State, the five western counties have in that time increased their woodland over 50,000 acres.

The percentage of loss by fires is much greater in the eastern part of the State. In 1879 nearly 14,000 acres of woodland were destroyed by fire, mostly at the east. Of these fires, fifty-two were set by sparks from locomotives; forty came from carelessly fired brush heaps; thirty-seven were caused by hunters; nineteen from careless smokers dropping matches, cigars, or burning ashes from pipes; three were from burning charcoal, and eight supposed to have been set maliciously or wantonly.

Whatever the cause may be, it is a startling thing for a man to find the flames driving through his lots, perhaps directly toward his buildings, and he only breathes free when he sees it has swept by him or been checked. When it is intended that a lot of land cut over shall again grow into a wood lot, and shall not be sown to rye with a view of bringing it into cultivation, nor into pasture, the better way undoubtedly is to let the cut brush and tops lie and decay on the lot, carefully excluding cattle or sheep; but if it is to be brought into pasture or restored to cultivation, and the brush is to be burned, the better and safer way is to lay the brush into windrows when cut, as is done by experienced choppers who understand their business. It is more convenient for them in getting about their work in handling the wood, and also very decidedly so for those who in sledding or in carting have to clear the wood from the lot. Timber should be cut during the fall of the sap, the rising of which softens the wood, which, if felled when full of sap, is apt to split and check in seasoning.

Probably the best time to cut wood as well as timber is in the fall and winter of the year, from September to January, and the worst time from February to June. A white maple cut in October and left in the log will be sound and bright the next fall, while the same, or a birch or white pine, cut in March, will be discolored and half rotted by August. In the care of a wood lot something may perhaps be done toward helping the rapid and strong growth by a little judicious thinning and trimming while the trees are still very young, though even that is questionable.

I have no doubt that it would pay to carefully trim a thicket of young white pines, beginning early enough to check the spreading habit, and to induce the tree to grow up straight and tall without leaving any black knots in the young tree; and when they are very thick — as they often are — I believe some thinning out would be advantageous.

Firewood. — There is often a great want of economy in the cutting, preparing and burning wood for domestic purposes. The fuel value of all the known woods of the country is given with great particularity in Prof. Charles S. Sargent's elaborate report, made for the census of 1880; but for our purpose we need take but three or four, and it is near enough for comparison to say, that the amounts of dry wood necessary to throw out a given amount of heat were as follows: — Hickory, 4 cords; white oak, $4\frac{3}{4}$; hard maple, $6\frac{2}{3}$; white birch, 7; soft maple, $7\frac{1}{5}$; Norway pine, 8; white pine, $9\frac{1}{6}$. It has been found that thoroughly seasoned wood contains about one-tenth of water; but green wood holds 35 per cent. of water, or 160 gallons of water to every solid cord, — about 1,280 pounds, — considerably over half a ton; and the farmer who hauls in twenty cords of green wood draws about thirteen tons or over eighty barrels of water. When green wood is used for fuel all this water must be evaporated, and the latent heat for doing it is five times as great as to heat the water to boiling; consequently, to evaporate the water of a solid cord of wood requires as much heat as to boil 780 gallons of water.

Wood will season best under cover if well ventilated; but if wood is hauled up green in the winter, it is better that it should be cut and split, that the winds of March and April may season it to a considerable extent before it is piled away; and every farmer ought to have a wood shed large enough to hold a year's supply of dry wood, never compelling nor allowing green wood to be burned. Not only the economy of the farm demands this, but especially is it demanded by a "decent respect for the opinions of others," in the health, comfort and convenience of the women of the farmer's household.

Fences. — It is undoubtedly true that one of the greatest items of unnecessary expense and loss, and therefore a hindrance, is in the unnecessary fences on our farms, and the consequent loss of land covered by and adjacent to them; and worse even, the fringe of bushes, weeds, and all manner of foul growth, which, on the one side and the other, usurp the land and scatter their noxious seeds often over acres.

The fence laws of Massachusetts, from a very early period in the history of the colony, within twenty years of its settlement, have been fixed and particular down to the present time. Owners of adjoining fields are required to keep between them a fence four feet high, in good repair, built of rails, timber, boards, stones, or other things which the fence-viewers shall consider equivalent; and it has been frequently decided by the courts that no one is compelled to fence on the highway; and consequently, if cattle turned out on the road to graze do damage on the land of another, their owner is responsible. Railways are required to fence the lines of their roads. And that is the gist of the fence law in Massachusetts.

The original cost of the fences in the State is something enormous, estimated as well as may be at about $23,000,000. The census of 1880 estimates the cost of building and repairing the fences in this State for the year 1879 at $618,503.

I think the amount of fencing is now being annually much reduced. Fences on the highways which have rotted down are to a great extent not renewed, and interior fences on the farms are being removed. There is no reason why fences dividing fields should be allowed to cumber the land, except that it is of course necessary to shut off the arable from the pasture lands; but there is no necessity for separating the mowing from the tillage land, for no good farmer should allow his cattle to run on his meadow, and there is no reason why they should be on the cropped land. Removing the fences gives the farmer an opportunity to cultivate clear out to the edge of his piece, and if at any time early or late in the season he wishes to go from one field to another, he can do so without going far around, or letting down bars or opening gates.

. The waste, however, is not confined to the building and everlasting repairs of fences, but is largely in the ground they occupy. On an oblong field of two acres the fencing will be seventy-six rods. A Virginia or worm fence, or an old-fashioned stone wall, one or the other of which makes the principal fence of the country, will certainly take four feet in width (a very small allowance), using up a quarter or an acre of land. A ten-acre lot will use, under the same fence, an acre and a quarter, and the twenty-three million rods of fencing in this Commonwealth would have under it thirty-one thousand two hundred and fifty acres of land, untilled and unoccupied, and worse, a resort for all kinds of vermin, and a rich and unmolested seeding place for all manner of abominable weeds.

In travelling through any part of Massachusetts by rail, one has a good opportunity to see much of the extent of this hindrance to our success, as on every elevated point of the road he looks over the fields near, and stretching off on the distant hills he sees long lines of zigzag fence or gray stone walls, crooked, irregular and ragged, crossing the farms in every direction, cutting them into lots of all sizes and forms, very picturesque in the far distance, but very unsightly and very expensive to the poor man who contemplates them from the standpoint of his own premises.

Where a division fence is necessary, and there are plenty of stones handy, there is nothing equal to a good double stone wall. A balance wall will do, but it is everlastingly tumbled down by hunters, berry-pickers, nut-gatherers, and that kind of cattle. A good double wall stands forever, and serves a double purpose, of absorbing the stones and boulders from the fields, and of a protection to crops. It is expensive, but as the farmer, with his own men and team, usually takes the time to do this when other work is not pressing, and when he thinks of the comfort of mowing the adjoining fields without being constantly obliged to dodge the rocks, he estimates the cost but lightly; though, if everything was put on a cash basis, it might cost him five or six dollars a rod, if he had far to haul his stones. The old-fashioned Virginia fence is, I believe, no longer laid in Massachusetts; chestnut trees, from which alone they were split, are too valuable for railway ties, posts and plank, to be wasted in a fence like that. Posts and rails come next, but a fence of these is also expensive, as is also one of posts and narrow boards. The average cost of each is something over a dollar a rod, and neither of them is very durable. The fence which comes to the front at the present time as the one which of all others is the cheapest, most effective, and the most durable, which thoroughly restrains animals, is unaffected by snow or wind, and easiest erected and maintained, is the barb wire.

The ordinarily fenced field is better with a jungle of weeds; the stone wall is the inaccessible fortress and resort of the enemies of the crops. All manner of insects and the smaller animals make their homes in these old stone walls. The farmer fights at long odds and great disadvantage with the enemies of his crops, when he establishes and maintains for them coverts alongside his fields. The existing fence system presents the expensive maintenance of a troop of minor evils and wastes, the enemies of and the hindrances to successful farming.

The perfect fence should be a defensive barrier, strong enough to repel all animals likely to injure the crops, while it must be durable, for fence repairs are costly, and must not be too expensive, and present as little resistance to wind and snow as is compatible with strength. The stone wall meets these conditions but imperfectly, and the wooden field fence perhaps even less so. If sufficiently staunch to defy assaults, it is exposed to harm from high winds; it decays early; it is always in peril from fire; and it is not entirely repellent, for cattle make friends with it at all points and know its weak places.

The barb wire seems free from all these objections, and is apparently much cheaper, costing, with posts and two wires, which will turn cattle, less than fifty cents a rod; and with posts and four wires, which will turn sheep and dogs, less than seventy-five cents per rod. A very great advantage is, that it can be easily secured to trees, and in that way be made to enclose a wood lot or an orchard, or temporarily to fence off part of an orchard, as is often desirable. If posts are used, they can be set much further apart than ordinary fence posts, and the wire up from the ground allows a scythe to be swung under the whole length, so that no weeds need be left at mowing.

As petroleum came to us when the vast products of the whale fishery failed to give us light, and as the coal beds yielded up their treasures for fuel when our woodlands were being stripped, so comes this new product for our fencing when advanced agricultural economy finds wood and stone inefficient. The only objection to the use of barb-wire fencing is the danger of injury from animals running against it, or jumping on it, and this does not seem to exist to any great extent. Horned cattle almost instinctively avoid it. Sheep are never hurt, and dogs must have great temptation to induce them to pass a four-strand barb fence. Instances have occurred where horses, and especially colts, have been cut, but in most cases it was the fault or thoughtlessness of the owner in turning his animals loose without acquainting them with the character of the obstruction. If a horse is led up to a barb fence and made to feel that a close approach to it will be met with a prick, he will give it a clear berth; the sight of animals is much more acute than that of man, especially at night, and once knowing the existence of the fence they will see well enough to avoid it.

Some over-cautious farmers have taken the precaution to nail a light rail on the top of the posts, at small expense, as a caution to animals.

The enormous amount of this fence set and in use during the comparatively short time since its manufacture, — something over 800,000 miles, and now being built at the rate of 200,000 annually, — not only in every State of this Union, but in Australia, New Zealand, and in almost every part of the globe, is a strong guarantee of its safety and popularity.

Manures. — A large item of waste exists in the treatment of manure, and none is more worthy of reprobation, because it is so generally and directly prejudicial to success in farming, and none other of the same extent can be so easily prevented.

Manure is the great motive power in all agricultural operations, especially in the worn and naturally unfertile soils of New England. Special fertilizers have their use; but farm-yard manure is the staple. Good and clean cultivation is very important; but unless the soil contains the elements of fertility it will avail nothing, and these can only be created and kept up by the constant application of manure or other fertilizers. Manures possess different degrees of power, partly from their inherent richness in nutritive qualities for plant-food, and partly from the rapidity with which they throw off those fertilizing ingredients to assist the growth of plants by assimilation. The great art of making and saving manure consists in retaining and applying to the best advantage the indispensable soluble portions, and placing them where they will do the most good.

The old practice of placing manure eight or ten inches under ground, or as deep as the heaviest plough would turn it, is much changed, and farmers at the present day desire to keep the manure as near the surface as they can and cover it, believing that the plant roots there find it most available. The farmer who should so grossly neglect his crops, either in the cultivation or at the harvest, as to lose or waste one-half, or any considerable portion, would be scouted at, and almost considered criminal, yet how many are there, passing for good farmers, who annually lose a very large portion of their manure.

Our census of 1875 gives 46,848 as the number of farm barns in the State, in which were made 422,478 cords of manure, valued then at $5.50 per cord, amounting to the handsome sum of $2,321,373.

What proportion of this is securely kept in barn cellars, or carefully under cover, there are no means of knowing; but a ride through the country, and an observation taken of farm barns at large, will show a very large number where the manure lies in piles under stable windows, receiving the drip of the eaves, which continually washes much of it into the highway, or to some neighboring brook, where probably the same thriftless farmer drives his cattle to water, instead of having running water in his yard.

The liquid manure, nearly or quite as valuable as the solid excrements, is lost, unless it drops into a cellar, or is preserved by some good absorbent, and this is too often neglected.

Manure depreciates much by exposure in an open yard a long time. Prof. Voelcker found, by actual experiment, that manure lying in a yard, spread about, exposed to all weathers, lost, in the course of a year, two-thirds of its value.

Manure may be profitably carted out and spread directly on the land, for a top-dressing, or to be ploughed or wheel-harrowed in. Many good farmers practise drawing out their green manure, daily or weekly, through the winter, and spreading it. Others make a large heap on the field in winter, to be distributed in the spring with a Kemp spreader or the cart.

The worst of all ways, is to cart out manure and leave it in small heaps on the lot. To warrant spreading manure in the fall or winter, unless done early, the land must be very flat; if it is descending, the manure is liable to be washed down by heavy rains and lost.

The saving of both solid and liquid manure is a great argument in favor of soiling cows, which ought to be more generally practised in the Commonwealth, — certainly, wherever pasturing is insufficient, or the land too valuable to be spared for pasture. If cows are kept in the stable, with only a run in a large yard, or a paddock, for a few hours to get water, sun and air, fed with a variety of green food, daily cut for them; first, winter rye, then early grass, then oats, then clover, then drilled corn, and last, late-sown barley, they will be better, will give more milk, will be under immediate supervision all the time, and a great saving is made in the manure; all which would be dropped in the pasture is saved, and also the liquid manure, by the use of muck, loam, sawdust, or some other absorbent, and as a cow makes, during the year, something over five cords of manure, — at $5.50 per cord, it is an item worth considering.

Harvesting. — There is a loss in not harvesting crops at the proper time. Grain of all kinds should be cut before it is dead ripe, lest it should shell out and be wasted; the straw, too, is much better. Corn should be cut up and stacked, or topped as soon as it is glazed. The general course is to cut it at the bottom, and allow it to ripen in the stack; a few farmers still top their corn, believing that the top stalks, well cured and bright, are worth more than the whole stalks after standing for weeks cut up and stacked. I believe the poorest way is to let the corn stand till it is entirely ripe. I tried a partial experiment this fall on a half-acre of Stowell's Evergreen, topping one-third, cutting up a third, and allowing the remainder to stand till frost. So far as the appearance of the grain went, that which was topped ripened off the soonest and best, while that which stood and ripened in nature's own way was certainly the poorest.

Grass should be cut very early, and is now mown much earlier than formerly. Good farmers now finish their haying, with the improved implements of the day, almost as early as those of former years used to commence. Grass should be cut as soon as it blossom, for then it begins to draw heavily on the land; by cutting thus early, we get finer, more succulent hay, and a much heavier crop of rowen, which is an important crop certainly for milk, and indispensable for sheep. With good weather, a mowing machine, the invaluable tedder and horse-rake, much hay may be secured the same day it is mowed, and none need be cut more than twenty-four hours.

Roots. — Roots should be harvested as soon as they are ripe and before frost, as some are exceedingly subject to freezing. Turnips, however, will stand considerable frost, and make their best growth quite late in the fall, "bottoming," as it is called, after other roots have ceased to grow.

It is probably the better way to dig potatoes as soon as ripe, and to put them dry in a cool place, they are then free from the ravages of the white grub and the wire worm, and if secured sound and in good condition, less liable to rot than if left in the field.

Weeds. — The loss from weeds, though not one that can be computed nor even guessed at, is undoubtedly very large, and their growth a great hindrance to farming, a fact which must impress itself upon every man of observation. How many weeds seem to be flourishing on some lots in every farm, while the roadsides are belted with them, and every one exhausting the fertility of the soil and the strength of the manure as much as any of the farmer's cultivated crops, without rendering him any return; scattering their pestilent seeds in every direction, bringing the realization of a part of the curse imposed upon the original cultivator at his fall. Weeds are propagated both from the roots and the seed. These last are generally the most troublesome as they are the most numerous, though couch or witch-grass spreads from the roots, every joint of which starts a plant. Much the same in that way is "spurge," of the euphorbia family, introduced as a garden flower, Gray says, but spreading from both root and seed with a rapidity, a tenacity and prolificacy beyond anything I had to deal with.

The annuals and biennials are spread from their seeds if allowed to stand till ripe. Noxious seeds are sold to us in the grass and clover seeds we buy; I am sure we pay for a great deal of sorrel seed under the name of clover. At a meeting of the Agricultural Association at New York, it was stated that the average of poor seeds from Germany was fifty-nine per cent. In a sample of orchard grass they found seeds of no less than forty-five different kinds of plants. A pound of clover seed showed 14,400 foreign seeds, most of them sorrel; but there were seeds from 45 plants not clover. Sowing land with such seeds means more than mere seeding down to clover. Most of the annuals can be kept in check by not allowing them to go to seed; but the number of seeds to a plant, and the length of time they will lie in the ground without losing their vitality is marvellous. I will only mention a few of the most pestilent. The dock has to each stalk 13,000 seeds; the May weed, 40,000; charlock, 4,000; burdock, 24,000. There does not seem to be any limit to the period during which these seeds will preserve their vitality. I have known a piece of land that had not certainly been ploughed for thirty years, which, after the first ploughing in spring, was yellow with the blossom of the charlock, or "cadlock," as commonly called. Dock seed has been known to have been in the ground twenty years and then germinate. The seeds of plants, too, will preserve their vitality after having passed through the process of digestion if they have not been crushed in mastication.

Most of the annuals can be destroyed by mowing them or destroying the seeds as with the daisy rake. Although daisies are perennial they do not spread much from the roots, and are destroyed by ploughing under deep. The ox-eyed daisy is by no means so vile a thing as the wild carrot, which has come upon us within a few years, covering highway sides and some fields till they look like a buckwheat crop in bloom.

If a farmer starts soon enough there is no great trouble, but only eternal vigilance to be exercised to keep rid of these two nuisances. As soon as the first one is seen pull it by the roots. The carrot don't show itself much till after mowing; then it throws its seed stalk up, with its white blossoms, very conspicuously, and is easily found and pulled. The dock must be taken out in the spring by the spade. I am satisfied that the seeds of the dock, daisy and other weeds arrive at a degree of ripeness to germinate sooner than we suppose. The Canada thistle flourishes on strong, heavy land; it can be killed by persistent cutting in August. Sorrel is one of the most pestilent of weeds, and most difficult to eradicate. It ripens its seeds before one is ready to mow, and reappears, year after year, unmolested by the plough and indifferent to manure. "Butter and eggs," or toad flax, a pretty, yellow-flowering weed, is a troublesome one, and will spread unless it is uprooted. All weeds will yield to heavy manuring and thorough cultivation, the chief point being to kill every one within reach and allow none to seed. One cannot begin too soon to destroy weeds when they are discovered, and must destroy them or they will destroy his crops.

The Thomas harrow, drawn over corn and potatoes when they are coming up, and occasionally after that till they are four or five inches high, destroys innumerable small weeds just starting, before they have formed much root, and it does not injure the crop, which has already thrown down roots two or three inches long, and strong enough to hold. In loosening the soil around the plants, and in the destruction of small weeds, its effect is more than equivalent to one tilling with the cultivator and hoe.

Insects. — The destruction of all kinds of crops by insects is a very serious matter, and apparently becoming worse each successive year; for while there may be occasionally an abatement of some one kind, it is soon in force again, and some new pest is added. They come in all ways, as Milton represents Satan journeying towards Paradise, and with scarcely better character or intentions.

"The fiend,
O'er bog, or steep, through strait, rough, dense, or rare,
With head, hands, wings, or feet, pursues his way,
And swims, or sinks, or wades, or creeps, or flies."

It is impossible to mention them all, and it would be of no use unless some prevention or remedy could be proposed. Against many of them there is no known help; while for others the means of prevention or destruction are impracticable and expensive. Among these are grasshoppers, army worms, May beetles, with the white grub, chinch bug, wire worm and many others, against which we can wage no successful war. Of the insects that infest our fruit trees, the worst — the canker worm — can be to a large extent restrained by a girdle of tar, tarred paper or printers' ink around the tree; so, also, as against the larvæ of the codling moth and the apple maggot it is some protection; but they can be prevented with considerable certainty and economy. If pigs or sheep could be allowed to run in an orchard three or four months and eat all the infected fruit that falls, those two pests might be exterminated in a few years; but the pigs are unsightly and unruly, and sheep, though a pretty sight on the landscape and useful, would be made into dog's meat before the orchard would be cleared of worms. In the same way, plums safe from the curculio can be raised in a poultry yard, and that is not objectionable. The tent caterpillars and others can be despatched by twisting off the pests with a wire brush and burning. My way is to draw a lock of cotton wool or tow through a wire loop on the end of a bamboo fish-pole, dipping this into a dish of kerosene and applying a match. It makes such a fearfully hot, quick flame, that judiciously handled it will burn the nest and every worm without injury to the limbs of the tree. The apple-tree borer can only be destroyed by digging it out of its burrow just above the surface of the ground. A mound of ashes or slaked lime or gas lime around both the apple and peach trees helps somewhat to prevent the work of the borer.

Rose bugs attack roses, grape-vines and cherry trees; from them there is no relief but hand picking. The potato-bug does not diminish in numbers nor appetite, but they are easily managed with two applications of plaster one hundred pounds, and one pound of Paris green, carefully dusted or sprinkled on, with no reasonable danger to man or beast. The currant worm yields to hellebore. The large white grubs with a yellow head, the larvæ of the great beetles that we hear humming in the tree tops in May, do an immense amount of mischief in grass lands, especially in pastures, eating off the grass roots and destroying the turf. They are also often ruinous to the potato crop. It is said that they live three years in the ground and that there is no way of exterminating them, and I believe it. In a pasture where I was getting out stone I found them for three years or more, two feet and a half deep in the ground, and of all sizes, from the tiny grublet of less than a quarter of an inch in length to the mature nuisance of two inches. Skunks and crows feed largely on them, and in that respect are our friends, though with some unfriendly manners.

The chinch bug is a terrible scourge to the western farmers, destroying fields of grain to the amount of $20,000,000 annually in the Mississippi Valley. Prof. Lintner, the accomplished entomologist of the State of New York, warns us of the approach eastward of this plague, it having appeared the past year in St. Lawrence County, New York. He thinks it can be checked by ploughing in the fall the land where they have been at work, turning it over flat to bury and smother them.

The black squash-bug, the yellow-striped bug and the squash maggot can be somewhat kept under by Paris green on the leaves, and an application of saltpetre dissolved in water about the roots, early in their growth. Prof. Lintner recommends the following preventive measures : — 1st. High culture, to impart strength to resist insect attacks. 2d. Rotation of crops, and their removal as far distant as possible from the soil which has become infested with insects. 3d. Selection of such seed as is least liable to attack, as the Lancaster or Fultz wheat against the Hessian fly. 4th. Late sowing, as, for the Hessian fly, after frosts occurring late in September. 5th. Refraining for a year or two, in an infested district, from the cultivation of crops specially attacked. 6th. Surrounding fields with a border or rows of more attractive food to concentrate the attack.

Dairying, when properly managed, and with the modern appliances to lighten labor and to perfect the operations of handling the milk, is profitable work on the farm ; if carelessly and slovenly done, there is a loss and a hindrance to success.

Of the breeds of cows, different ones have their special admirers. Doubtless there have been great milking families among the Shorthorns, but their large size and early maturity have tempted farmers to pay more attention to breeding them for the shambles than for the dairy. The Ayrshires give a large flow of milk, rich in caseine and excellent for cheese making, but not specially rich in butter fat. The Herefords and Devons are not large milkers ; the Holsteins are showing enormous records of milk, and their importers and owners claim large butter products ; but at the present the Jerseys, in popularity, either pure bred or crossed on other stocks, far exceed all others, though the Guernseys, larger and very rich milkers, are their closest rivals.

I do not purpose at this time to enter into the matter of feeding cows, nor of treating the milk and making butter, at any length. While corn meal, with good hay, is the staple for butter, bright corn stalks and wheat bran form desirable portions of the feed; roots act as alteratives; and to keep the digestive organs in good condition, cotton-seed meal and ensilage may be fed in moderate quantities. But the good dairyman must exercise eternal vigilance to see that his cows eat nothing which may give an "off" taste to the butter.

There is still a difference of opinion as to the best method of setting the milk, — in old-fashioned, round pans, large square shallow pans, or submerged in creamers. This last method has the very great advantages of lessening the labor of handling, and of keeping the milk free from dust or offensive odors, which milk so readily absorbs, and which are sure to make themselves manifest in the butter. Thorough cleanliness is the underlying principle in butter making; as much as possible in the stable, and entirely so when the milk reaches the house, where it must in all its manipulations be kept especially free from any foul smells, such as come from kitchen cookery, tobacco smoking, nasty boots and clothes, and rank vegetables. Skimming, churning, working and packing should be thoroughly performed. Especial attention should be paid to the importance of skilfully salting the butter, neglect of which, more than almost anything else, impairs the taste and the texture of the butter, bringing it down from fifty-five to twenty-five cents per pound. The best butter salt, free from magnesia, soda and other matters found in impure salt, should be used, and should be made as fine as flour. The best way is to grind it in a mortar with a pestle. It then is thoroughly dissolved and spreads through every part of the butter, flavoring it equally, and from the affinity of the salt for the moisture in the butter, every infinitesimal particle of salt takes an atom of water, which is diffused invisibly through the mass, making it of a uniform, dry, fine texture, while with good salt as usually put in there are innumerable undissolved crystals of salt and globules of water everywhere to be seen, which affect the appearance, the taste, and very speedily and effectually the keeping quality. The microscope shows this difference in a wonderful manner.

There has been much fine poetry as well as prose spent on the beauties of farm life, "the lowing herds," "the sweet breath of kine," and the charms of the dairy maid. A lovely little picture of milking is by an English poet, Bloomfield: —

"Forth comes the maid and like the morning smiles,
The mistress, too, and followed close by Giles.
A friendly tripod forms their humble seat,
With pails bright scoured and delicately sweet.
The full charged udder yields its willing streams,
While Mary sings some lover's amorous dreams,
And crouching Giles, beneath a neighboring tree,
Tugs o'er his pail, and chants with equal glee.
As unambitious, too, that cheerful aid
The mistress yields beside her rosy maid.
With joy she views her plenteous, reeking store,
And bears a brimmer to the dairy door.
And now the dairy claims her choicest care,
And half the household find employment there.
Slow rolls the churn; its load of clogging cream
At once foregoes its quality and name,
From knotty particles, first floating wide,
Congealing butter's dashed from side to side.
Streams of new milk through flowing coolers stray,
And snow-white curd abounds and wholesome whey."

But at the present time the nonsense is all knocked out of that poetry; the milkmaid now is red-headed, freckled-faced, wears tan-colored overalls, and her name is Patrick. The conveniences for handling the milk and cream, and churning and working the butter, have been so wonderfully increased as to immensely lessen the labor of the dairy. Nevertheless, no farmer should allow his wife, with all her other burdens and cares, to churn, work and pack any large amount of butter; that should be the work of a man. The farmer himself should know precisely how to do it, and when his duties call him elsewhere, let him clean up a man or boy and carefully instruct him.

Many of the best butter makers in the State make their own butter; partly from choice, to have it always right and uniform, and partly from a laudable desire to ease the women's work; and they are the men who take an honest pride in doing it well, and who consequently get from fifty to seventy-five cents a pound for their butter. The handling the milk and cream, and the product itself, in making fifty or even thirty pounds of butter, is too much of a lift and strain for any woman, except she be very robust and strong. Churning and working butter in a chilly cellar or milk-room, for the coolness of the place to make the butter firm, plunging her hands and arms into ice-cold salted water when she ought not, lifting buckets of cream and bowls of butter, have laid many a wife under the green turf, a sacrifice to her husband's greed and her own ambition.

Laborers. — The difficulty of hiring good farm laborers is certainly a great hindrance, and the solution of this important question is far off.

Farmers have tried sending to the cities for immigrants, but not always, perhaps not generally, with satisfactory results. The men are ignorant, unskilled, often stupid when no worse. A new-comer on a farm in Vernon, a few years ago, was on one Sunday morning given the oil can, and directed to go out and grease the wagon; and he did, top, body, wheels, boot, and even the cushions. The owner was not pleased nor grateful, nor did he attend divine service that day. Another was told by a farmer in a neighboring town to take a brush scythe and bog hoe, and clear up the weeds and brush on a certain lot, unfortunately out of sight. He returned the second day and reported that he had finished; and he had, so thoroughly that not one was left of four hundred apple trees set on the lot two years previously. The owner being one of the world's people, I was told that the English language was considerably torn to pieces; but the unfortunate laborer, being a fresh German, didn't fully comprehend the situation. Such experiences are not calculated to improve the temper, nor to inspire us to cultivate our foreign relations.

Improved animals. — A farmer, to be successful in his stock raising, if he cannot afford thoroughbred animals, should by all means grade up his stock of all kinds by the use of a thoroughbred male, which is always obtainable at some neighboring farm. For ordinary purposes of the dairy and for the shambles, grades are better than thoroughbreds, and there is no better evidence of thrift in a farmer than to see him carefully improving his stock in that way.

Implements. — A farmer should buy the best implements to be had, when he can afford them, and he can soon do that if he starts fair, free of debt; remembering that the purchase of a good machine or implement is the best investment he can make in saving labor and time, and in the comfort and ease with which he can accomplish his work.

The subjects embraced by the title of this paper would bear dilatation to an extent far exceeding the proprieties of this occasion. Many have been unmentioned, many *only* mentioned; but the intended purpose will have been answered if any thinking farmer shall be induced to better his condition by avoiding or freeing himself from some of these hindrances to successful farming. Of the particular management within the house, and of the family, it is unnecessary to speak; for I believe it is a fact that where the farmer is himself precise, neat and careful when in and regular and orderly in his arrangements without doors, he never fails to be encouraged, seconded and generally surpassed by the neatness, order and good management of the good woman within.

If there be light within the house; if there be sunshine on the results of the daily work outside; if there be order in the family and cheeriness in the home; if there be one thing more than another that lightens labor, soothes disappointment, makes the farm bright, the farmer contented and happy, and contented because he is prospering; which makes

"The wheels o' life gae down hill scrievin,
Wi' rattlin glee;
That cheers the heart o' drooping care;
That strings the nerves o' labor sair,
At's weary toil;
That even brightens dark despair,
Wi' gloomy smile;"

that turns up the dark cloud of hindrances to successful farming and shows the silver lining beneath, — it is the work of the woman.

To his wife is the prosperous and respected farmer most indebted for his success, — to her management of the indoor work and of the household; to her consoling companionship in all his troubles; and to her quick-witted, usually safe and conservative advice. She for him forsook family, home, everything; casting her bread upon the waters, trusting that after many days it should return to her; and it is the duty and should be the joy of that husband to see that she is not disappointed.

But how many have early started out to taste the anticipated happiness of the life of a farmer's wife, only to find it, as in after years they ate, but as the "dead sea's fruit of ashes."

How much the farmer, absorbed in his severe out-door avocation, is apt to forget the trials and hardships and loneliness of her whom he has taken to love, to cherish, and to make his equal and his partner in everything.

Must it stand as an everlasting reproach to us, that the life of a New England farmer's wife is one of hard, uncompanioned endurance, which originated that harsh old couplet, —

"Man's work is from sun to sun,
But woman's work is never done"?

Every farmer should regard with practical, compassionate assistance, the labors of an ambitious, uncomplaining wife in the kitchen, at the laundry and the dairy; bearing, as she does, the superadded cares of maternity and the endurance of the unnumbered and unmentioned sufferings incident to her sex. The man who, not selfishly perhaps, but thoughtlessly, has allowed his wife, earnest and anxious to promote his interests and comfort, to gradually take upon herself one after another of the heavy, constantly accumulating burdens in a farmer's family, till they have broken her strength and crushed out the vitality of her spirit by a premature old age, will find too late, alas, for his own comfort and peace of mind, if he have any sensibility left, that he has brought upon himself the greatest and most irreparable of all the hindrances to successful farming.

Mr. Phillips. How are our young men to get farms without mortgaging them, under our present social system?

Mr. Grinnell. I don't know.

Mr. Phillips. Is there any remedy?

Mr. Grinnell. I only attempted to delineate some of the troubles he would have if he did attempt it; but it is a question which must be solved, in every case, by itself. Of course there are exceptions. There are men who have bought farms and given mortgages and been successful, eminently so. I venture to say that there is not a man here who does not know of such cases. I attempted to picture the condition of a young man who had not made a success. Of course a man must sometimes, in buying a farm, mortgage it, and if he is fortunate, if I may use that word, for there is no such thing as *luck*, —

> "One constant element in luck,
> Is genuine, solid, old Teutonic pluck," —

if he is fortunate and has strength to struggle along, he may succeed. How often he does not. I only spoke of some of the hindrances to farming.

Mr. Ware. I would like to ask the essayist if he meant to say that a cow would make five cords and a half of manure in one year? If so, a herd of fifty cows would make 275 cords in a year. I don't know of any such quantity being made by a stock of cattle of that size. Did you mean to say that?

Mr. Grinnell. Solid and liquid. My authority is Mr. Hadwen.

Mr. Myrick. The essayist has referred to the excessive burdens thrown upon the housewife, and the consequent injury to her health, as one of the greatest hindrances to successful farming. Why is it not possible and practicable to avoid many of the labors of the housewife by adopting the system of co-operation which we are learning to apply so successfully to dairying? We have co-operative dairying, and why may we not have, in towns like Great Barrington and in many of the villages with which New England is covered, co-operative laundries, where all the washing and ironing may be done; and perhaps we might have co-operative bakeries. The idea is a new one here, but it is not newer than the idea of co-operative creameries was a few years ago. Perhaps if the women would take hold of that with as much energy as they usually take hold of any matter in which they are interested, they might make it successful.

QUESTION. The essayist referred to sawdust as a bedding for cattle. Would that have any injurious effect upon crops when carted out the next year?

Mr. GRINNELL. There are others who can judge about that better than I can. I don't think the quantity of sawdust which would be used as bedding would have any injurious effect upon crops. It is only good as an absorbent. It is a long time in decaying. There is, however, a decided difference in the value of sawdust from different woods. I never use sawdust myself to any extent, except sometimes under pigs. I do not consider it a desirable material for bedding, nor to be used as an absorbent, when I can get anything better, but I should say it would not be injurious to land.

Mr. SLADE. In answer to that question I would state an item of experience. I saw horse manure from a stable where sawdust was used for bedding spread broadcast on a bed of asparagus and it was decidedly injurious. Where the same material was ploughed under and the land seeded, it seemed to have a very good effect.

Dr. VAN DEUSEN. Would there be any essential difference between the use of sawdust and chip manure, or dry chips scattered upon the land? I have had a little personal experience in regard to the use of chips. I think the character of the soil upon which this material is applied makes a wonderful difference. The use of chip manure or sawdust upon a clay soil is beneficial; I think there is scarcely anything that can be applied with more profit. On my father's farm there was about one acre of poor land which was a heavy clay soil. Upon that acre a large amount of dry chips and chip manure that had accumulated in the shed for years was thrown, and spread over it, I should judge, to the extent of six inches in depth, and ploughed in. From that time, which was over twenty years ago, there has not been a more fertile acre of land upon the whole farm than that acre. Consequently, I think it depends very much upon the character of the soil upon which you put your chip manure or your sawdust.

The CHAIRMAN. Very likely such an application on such soil would improve the mechanical condition of the soil and be a permanent benefit.

Mr. ———. We are told that no good farmer will turn his cattle upon a mowing field. When a man has twenty cows and his summer pasture fails, and there are two months or six weeks between that time and winter, what is he going to do with his cattle?

Mr. GRINNELL. If he has twenty cattle, he ought to put in about eight acres of drilled corn. If he cannot put in that much, let him put in less. Then if he has a piece of land which he wants to seed down, let him plough it and sow barley in July. He can mow that until November, or almost until this time. Barley will stand a good deal of frost. He can cut that and use it to supplement his summer feed. The prudent thing for every farmer to do is to drill in some fodder corn, — "sowed corn," as we call it. It cannot come amiss. If you do not want to eke out your pastures, there is nothing better that you can cut up, dry, and put into your barn. If in good condition, it is better than herdsgrass for cows.

QUESTION. What is your opinion of ensilage?

Mr. GRINNELL. I have no opinion to give at present.

Mr. SESSIONS. I would like to have the essayist tell us why it is any worse to have cows eat the second crop of grass in our mowings than to mow it with the mowing machine?

Mr. GRINNELL. The first reason is that cows gnaw a great deal closer than the mowing machine cuts. Another reason is, that if a man puts his cows into a mowing field he wants to keep them there until they have eaten the last morsel. He will turn them out and let them stay there after the ground is frozen, when they ought to be in the barn.

Mr. SESSIONS. There is reason in all things. Why condemn a thing *in toto* because it may be carried too far?

Mr. GRINNELL. To go into a comparison of the mowing machine with a cow's teeth, I think myself that we mow too close. I think that one reason why it is so difficult for us to keep our herdsgrass-ground seeded is that we cut our grass with mowing machines closer than the scythe did. I only said that it was bad policy to feed mowing lands in the fall, and you ask me if it is any worse than it is to mow closely?

Mr. SLADE. I would like to ask the gentleman if he has got any herdsgrass that he wants to trade off for corn-fodder, even? If he has, I will tell him where he can find a customer.

Mr. GRINNELL. Exactly. Down your way your herdsgrass stood until it was dead ripe and was no more fit to eat than so much straw. I see a few farmers here — I mean *real* farmers, not strawberry growers — and I believe there are farmers who say that cornstalks, well kept, will make as much milk as hay.

Mr. SLADE. I don't believe it.

Mr. GRINNELL. Prof. Sanborn says so.

Mr. SLADE. I don't care what anybody says; it is not true. That doctrine has been preached in the State too long; it is incorrect. If science, so called, or some doctor of agriculture proclaims that, he proclaims what cannot be proved. Corn-fodder is not worth two-thirds the value of well-cured herdsgrass for milch cows.

The CHAIRMAN. I would like to say in confirmation of the position taken by Mr. Grinnell in regard to pasturing meadows in the fall, that I know a farm in the south end of this town that has kept up its fertility and continued to produce good crops for the past ten or a dozen years, and it has not been pastured. The condition is such in regard to fencing it, that it cannot be used for that purpose, and that is really the only reason why it has not been done. I suppose that what he means by pasturing meadows in the fall is pasturing them at this time of year, and I presume that if you should go out among these hills to-morrow, you would find many places where the cattle are still running on the mowings. That undoubtedly is the kind of fall pasturing which the gentleman very sensibly protests against.

QUESTION. Was your meadow in the south part of the town mowed a second time?

The CHAIRMAN. Some of it.

Mr. RUSSELL. Will not the same rule hold in regard to mowing the second crop with a mowing machine?

Mr. GRINNELL. Undoubtedly it would, if mowed late in the season, but we do not mow so late. The second crop is mowed often as early as September.

Mr. NATHAN EDSON of Barnstable. I think every gentleman should use his own judgment. I will take an acre of ground that will mow three tons the first time and I will go on it and mow a second time and get perhaps half as much. The grass will naturally come up and the field be covered with a heavy third crop. I think it is good policy to pasture that down partially; because, if you don't, it is going to interfere with your mowing machine next year. I think the dead grass smothers out the next crop to a great extent. I think it would be better to pasture such a mowing lot.

Mr. HADWEN. I agree with the essayist, that if you cut a good first crop early in the season you get hay that will make good milk. Then you have an opportunity to cut off a second crop, if your land is rich, and you get a good crop of rowen. But every judicious farmer will cut that crop of rowen early in the season. Then, if the land is in good condition, there comes up an after-growth which should by all means remain, because the roots of the grasses derive some nourishment from the tops, if they have an opportunity, and if you destroy that opportunity, either by cutting it a third time or by pasturing it close, you impoverish the roots of your grasses to a very great extent. Those are the reasons why good farmers should be very careful about taking off or leaving the grass short in the late autumn. We all know that frequent mowing of a lawn has a disastrous effect upon the sod and the grass roots. It is now conceded that to keep a good lawn, you must let the after-growth come up to nourish and protect the roots.

Mr. ELBRIDGE CUSHMAN. I should regret very much to have this Board pronounce against raising corn for the production of milk. Living as I do upon a farm, the soil of which is mostly of a light nature, I should be unable — and I speak after twenty years' experience in the business — I should be unable to make milk for the Boston market, and sell it at present prices, were it not for the corn land; and when gentlemen say to me that a pail of milk cannot be made with a bundle of corn-fodder, or fodder corn, either, I cannot believe that they have given the matter the attention that

I have. I have raised twenty-five acres of corn-fodder the present season. I have forty head of cattle to-night foddered with it; a portion of those are milch cows, and their milk will go to the city of Boston in the morning. I state what I know when I say that I can make milk as cheaply, on my light soil in Plymouth County, as a farmer in Worcester or Middlesex can make milk on his heavy clay soil. He may raise his timothy and I will raise my corn. Let it not be told that this State Board of Agriculture, of the good old Commonwealth of Massachusetts, discourages the culture of corn.

Mr. Slade. I don't know whether the gentleman aimed his shaft at me or not; but the Board of Agriculture does not set its face against raising corn or corn-fodder, or using the products of corn, or anything of the kind. I rose a few moments ago to repel that heresy that has been taught from time to time, that a ton of corn-fodder was equal to a ton of herdsgrass. Everybody raises corn-fodder. I am feeding my cattle, I am sorry to say, on corn-fodder, because I cannot afford to feed them on herdsgrass. I have to raise a crop of corn-fodder and so does everybody else; but I will give four tons of corn-fodder for two tons of herdsgrass any time. I would like to do it.

Mr. Sessions. This is rather a fruitful subject. It seems to me there is corn-fodder and there is other corn-fodder. I might agree with brother Slade's position if he would let me select the corn-fodder, and I doubt not that I should agree with brother Grinnell's position if he would let me select the corn-fodder; for every one knows that if corn is cut up after it is too ripe, or after it is frost-bitten, and shocked in a shiftless way, so that the weather will destroy the quality of it, it is poor stuff; it is like straw; it is like herdsgrass that has stood too long and been wet several times, and has been housed in a shiftless manner. But if corn is cut early, shocked up, properly seasoned, and housed in the right season, the portion of corn-fodder which well-fed cows will eat is worth, in my opinion, pound for pound, as much as the very best of English hay. No man that knows about feeding cows will feed them all corn-fodder, if he can get anything else for them. Cows need a variety of food. I repeat it, from an experience of years in feeding dairy cows, the portion of good bright corn-fodder, fed once a day, that dairy cows will eat, is worth as much, pound for pound, as good rowen, mixed with another feed of English hay and a suitable proportion of grain. I believe it from my own experience, I believe it from the experience of my neighbors; but, as I said before, if you take weather-beaten corn fodder, it is good for nothing, of course.

Mr. H. Garfield, of Lee. I am very glad to hear the remarks of my friend in relation to corn-fodder. There is great difference in corn-fodder. Timothy, and all our grasses, after they are cut, are usually put under cover within twenty-four hours. You cut your corn-fodder and put it under a shed, or where it can have air and cure under cover, and I would as lief have a ton of that as a ton of hay to make milk. But if corn-fodder is stacked out and exposed to storms and bad weather until it is damaged, and then put into the barn, it is good for little to make milk of. I think more of corn-fodder to make milk than I do of hay. I get more milk from it and the cow is in a better condition. I expect to feed it until March. I would say that I would give one feed of hay a day and two of corn-fodder, cut up. If cured and treated as hay is treated, I would as lief have a ton of that as a ton of timothy hay.

Mr. Grinnell. My remark was in regard to topping corn. Some farmers still continue the practice of topping corn. I think it is true that the tops cut off and properly cured and put into the barn are as good as hay. I was not speaking in that connection of corn that was cut up at the roots and stacked. I spoke of tops cut off, properly cured and put into the barn.

Mr. Henry Noble, of Pittsfield. I am fearful that fodder corn is not properly appreciated by our Berkshire farmers. My experience has been that of Mr. Sessions. For making milk, a ton of well-cured corn-fodder will give me as much milk, and milk of a better quality, than a ton of well-cured dry timothy.

Now, with regard to summer pastures. I have none, but I have forty cows. I have no provision for them except about five acres of pasture. Those cows have had nothing from the 15th day of May until the first day of October except what they have got upon those five acres and corn-fodder. I have never had cows in any better condition at this season of the year than they are; I have never had my customers complain less of poor milk than they have done this past summer.

I think that the subject of feeding meadows is not properly understood. I prefer to have my forty cows run on that meadow a couple of weeks longer, if they can, and eat the surplus grass that has grown there since haying.

Mr. Cheever. I would like to ask the gentleman whether the heavy feeding of forty cows on five acres of pasture has injured it severely, or whether it has rather improved it?

Mr. Noble. I change the pasture every second year, plough the land, and some other pieçe is given to the cows. The rankness of the soil begins to produce grass which the cows reject. Consequently, that land has to be cropped, and the cows turned on to another piece, which they very soon bring up to the same condition.

Adjourned to Wednesday.

SECOND DAY.

Wednesday, Dec. 3, 1884.

The Board met at 9.30, Mr. Wheeler, of Great Barrington, in the chair.

In the absence of Dr. Billings, Secretary Russell read the lecture prepared by him on abortion in cows.

ENZOÖTIC ABORTION IN COWS.

BY FRANK S. BILLINGS, V. S., OF BOSTON.

It is first well that we come to understand the nature of the subject which we are about to consider. Abortion is an accident which occurs during pregnancy. It is not a disease, and, in this case, is the result of the action of an unknown quantity, which practical observation has led us to think is of an infectious nature.

Even pathological changes, *i. e.*, disease products, which might be supposed to anticipate so serious a disturbance in the normal functions of the female organism, do not seem to have attracted much attention, so that we shall have to pass over this part of our subject with the simple remark, that some authors have observed fatty degeneration in the epithelial cells covering the placenta, but have given us no indications as to what produced this condition. This form of degeneration is known to be a *cause of abortion in individual women*, often occurring at about the same period in each pregnancy, but it never assumes an endemic character.

Enzoötic abortion, as known to veterinarians and agriculturists, is essentially a bovine malady, although Fleming calls attention to outbreaks of this trouble in other animals, and even in women, sometime in the last century. They are not known to the medical profession of our day, however.

The entire subject of abortion in cattle is of such an hypothetical nature, that its study is a most unsatisfactory task to those who desire to find some confirmed facts in the path of medical research on any subject.

So far as knowing anything about it is concerned, the farmer knows as much as the veterinarian, and he knows: —

1st. That it occurs.

2d. That the manner of feeding, housing and general care, play no essential part in causing it.

3d. Observation and experience, supported by a very few illy-controlled experiments, seem to indicate that we have to do with an accident which has for its cause influences of an infectio-contagious nature.

I have said that veterinarians know very little about it. This is especially true of English and American authors. Williams, the best known in America of British authors, makes no mention of it; and, naturally, we should not look for any in Robertson's late work on Equine Diseases. Steele is most unsatisfactory, and Woodruff Hill adds nothing to what Fleming has given us, from whom he largely quotes.

Mr. Fleming is influenced by the work of continental veterinarians. I know nothing about it myself, and the conclusions which will be arrived at are entirely drawn from the critical study of the writings of others. It would really seem as if very little attention had been given to the subject by the profession in England; for if we look over the contents of the London Veterinary Journal during its existence, from 1875 to date, we shall find the subject indexed but once, and then as a translation of a German article. The reports of the papers read and discussions held at many of the meetings of English veterinary societies have also been published in this journal, and though not indexed I have looked them over in vain for any allusion to this subject.

If we turn to French and German literature we shall not find very much satisfaction, though more has been written upon the subject and more thought given to it. The hypothesis that it is due to infection is well defended and supported by some experimental proof. The best treatises upon this subject are two of purely American, and, strange to say, neither of them of veterinary, origin. One of them is to be found in the Transactions of the New York Board of Agriculture for the years 1867, 1868 and 1869, and is the report of a commission appointed by the governor of that State for the purpose. The other is a report of the discussion held at the "Farmers' Meeting" of the Massachusetts Board of Agriculture, published in 1883. The New York commissioners do not seem to have arrived at a suspicion of the infectio-contagious nature of the trouble, as we shall eventually see; while the New England farmers appear to have become more or less convinced of it.

After looking over all these authorities, the reader will, like the writer, come to the conclusion that it causes an immense loss to the cattle interest, and further, that it is one of those questions that it becomes the duty of the State to spare no expense in having its causes sought after in the most exact and experimental scientific manner.

This trouble does not appear to have attracted much of any public attention until towards the end of the last century. Our New England farmers speak of it as something belonging to their day and generation, and as an ever-increasing evil. It should, I think, be classed with those maladies that I have termed diseases of association, or civilization, though, as already said, abortion must not be looked upon as a disease *per se*, — that is, it is due to causes which gradually find their origin in the long continued cohabitation of the same locality by animals of the same species, until special — unknown — conditions are produced which favor, or lead, to the development of specific infectious germs. That enzoötic abortion can cause most serious losses to the cattle interests of our country is most effectually shown by the N. Y. Commissioners' report.

From various townships they collected statistics of 35,919 cows reported as having been pregnant; of these, 2,057, or .057 per cent. aborted.

The per cent. of abortions among the cattle of 14 townships was 0.06. The average number of cattle aborting in each, 22; the average number of affected herds, 29; of non-affected herds, 19.

I would here state that Mr. Sturgis, of the Wyoming Stock Growers' Association, recently wrote me that while from their manner of raising cattle it was impossible to gather statistics, still it could not exist to any alarming extent, as no complaints had been caused by it among range cattle.

The report alluded to further says, — with regard to the period of pregnancy at which abortions were noticed to have occurred: —

In the first month, aborted,	0
In the second month, aborted,	1
In the third month, aborted,	10
In the fourth month, aborted,	66
In the fifth month, aborted,	106
In the sixth month, aborted,	198
In the seventh month, aborted,	341
In the eighth month, aborted,	360
In the ninth month, aborted,	238

These figures agree with the observations of the most competent veterinarians, who look upon the *seventh and* *eighth months* as those in which abortion most frequently occurs.

With regard to the time of the year in which this accident is most likely to occur we find the following: —

April, abortions,	86
May, abortions,	27
June, abortions,	2
July, abortions,	2
August, abortions,	1
September, abortions,	18
October, abortions,	40
November, abortions,	115
December, abortions,	215
January, abortions,	354
February, abortions,	426
March, abortions,	358

Such statistics have but little etiological value; they show, however, that the increase in the number of abortions bears a direct relation to the period at which most cattle men desire to have their cows "come in," *i. e.*, to be ready for the spring grasses. They show further, that some general cause must be at work at such times, other than the manner of feeding, etc.; for if ergot, as has been assumed, was a cause, the cows would be as liable to gain access to it in November and December as in January, February and March, and sufficient time would have even then elapsed to allow its deleterious action to develop, if at all.

The N. Y. Commissioners also gave attention to the influence of the bull, if any, with reference to the age at which it was used for service.

No. Cows Impregnated.	Bull 1 Year Old.	Bull 2 Years Old.	Bull 3 Years and Over.
Carried to full term,	9,740	19,530	1,482
Aborted,	522	1,340	74
Per cent. of abortions,	.05	.064	.047

It will be seen that these figures indicate a slight advantage in favor of the older bulls.

A Prussian veterinarian reports a singular case with reference to two bulls, one three and a half and the other two years of age. Of some forty cows served by the older bull, all aborted between the sixth and thirteenth week of pregnancy, while the accident did not occur in any of those served by the younger. In neither case have we any record of any abnormal conditions being present in the bulls, so that all the value such observations have is to indicate that more attention could be well given to the bull question; but not with regard to enzoötic abortion, but rather with reference to tuberculosis and sporadic abortion.

Roloff reports a case in which *all the cows* in one stable aborted, while of those in another on the same farm none aborted. Care, feed and ventilation were exactly the same in each case. In another stable where traffic caused an almost constant change in the animals, which were of every variety of breed, and gathered from all parts of Germany, nearly every pregnant cow aborted, one after another.

In another, abortion still continued after every possible change in the manner of feeding had been made.

Abortion has been frequently observed to occur in cows fed upon brewery and distillery refuse, by Richter, in Germany, director of the Berlin veterinary school. He claims that looking upon an insufficiency of salt in such feed as the cause, it entirely ceased when this want was equalized by the addition of a sufficiency of saline ingredients to the food.

It is only necessary to add that this was not our form of abortion.

Roloff also reports cases in which he has observed the trouble existing in stables for a number of years with ever-increasing intensity, until nearly every gravid cow aborted. This shows that *the cause* can become domiciled in a given locality.

In a stable, on a farm in Saxony, one cow after another aborted, while of those in another on the same farm none aborted; but upon a maid assisting at an abortion in the first stable, going back to her regular work among those of the second, the cows in the latter began to abort, the evil continuing for a long time.

These examples, particularly the last one, are sufficient to indicate that there must be some special, specific cause at the bottom of this trouble which we must consider, and that it must be of an infectious or contagious nature. It must be remembered, that while all contagious diseases are of an infectious, still, all so-called infectious maladies are not necessarily of a contagious nature.

It has previously been remarked, that the New York commission did not seem to have had the idea that the cause of this disturbance was of an infectious material; hence it is but just to them to let them speak for themselves.

They appear to have come to the conclusion that abortion was chiefly due to unnatural conditions produced in cows, from the inconsiderate forcing process to which man's greed subjects the sexual and milk-producing organs, not only with reference to degree, but also with regard to the unnaturally early age at which we cause their functions to be called into full activity.

After describing the manner of "selection" by which man has gradually produced our present milk-machines, they tell us: — "That if, however, instead of following these rules, the attempt be made to get a large increase at once; first, by forcing the uterine reproductive apparatus into activity before the animal has arrived at full maturity, and afterwards by continuing the drain upon the mammary secretion, at the same time that a second fœtus is getting its supply from the placenta. *By the first practice the uterine reproductive apparatus is weakened, and a liability to abortion established. By the second, the natural supply of blood which should go during pregnancy to the uterus to nourish the young, is continued to be drawn in the other direction towards the udder; arrest of development from inanition is endangered, and when it occurs (? B) the fœtus is expelled as a foreign body.*" It is scarcely necessary to say that such deductions are entirely of an *a priori* nature with reference to enzoötic abortion, though a sporadic case may occasionally occur, or even several cases, in a very large herd which is subjected strongly to the forcing system.

Even this report frequently quotes cases of abortion occurring in herds on the introduction of a cow from a farm on which it had prevailed; but this does not seem to have made any impression upon the minds of the commissioners. The latter sum up their conclusions as follows: —

"The affirmative results obtained are, —

"1st. That cows which have first calved at or under three years of age, are more liable to abort during their subsequent pregnancies than those that first calve at three years of age or over, in the proportion of 5 : 3."

"2d. That cows subjected to removal at any time, are liable to abort over those raised on the farms in the proportion of 7 : 4½."

This requires more sceptical observation.

"3d. That cows subjected to removal during pregnancy are liable to abort over those not pregnant at such times in the proportion of 9 : 2."

One might here ask what is meant by "removal." Whether from one farm to another near by, which would be no more than a walk to pasture, or carting, or what? The above assertion is so loose as to lose its value, if it ever had any.

"4th. *That arrest of development is the condition immediately preceding abortion.*"

In support of this they say: "That of 4,163 abortions in the years 1867, 1868, 3,597, or 86 per cent. of the young were reported as 'dead' at the time they were aborted."

Still another cause has been considered by many to be very intimately connected with enzoötic abortion, viz., ergot. The conditions produced are known as of which we heard so much during the spring of 1884, from Kansas.

For quite an exact and detailed account of the invasion of grains and grasses by this parasite, I must again refer those interested to the New York report, the great value of which is, that they have very ably prepared the ground for further examinations by showing that many things which have been assumed to have casual connection with bovine abortions do not have any, at least with its enzoötic form.

With regard to plants liable to cause it they say: "That they have been unable to find any plant, in itself healthy, of which there is a reasonable probability of its being the cause of this trouble, affecting as it does so large a number of farms. "Ergot was found on ten different plants, of which six are among the more common meadow or pasture grasses."

No positive connection could be discovered between the existence of ergotized grasses and abortion.

Some cases have been reported in veterinary journals, which, taken by themselves, would seem to indicate that ergot can cause abortion in cows.

Heusinger says: "Ergot that is gathered with grains or grasses in an extremely hot and dry harvest season, not only falls out easily, but is of a very pale color and inactive, while in wet summers, the ergot is black, not easily detached, and possesses its active properties to the fullest degree."

An outbreak of ergotism is reported in "The Academy," Jan. 9, 1875, as having occurred in New Zealand, which largely interfered with the productivity of the sheep and cattle. It came to pass in the fall; the afflicted animals were lame and had convulsions. It ceased upon their being changed to other pastures. Hazelbach reports a like case in cows fed upon wheat in which were large quantities of Ustilago Maidis — rust. No further case occurred among the cows, when this food was taken from them. I have already alluded to that singular outbreak in Kansas that one veterinarian declared to be the "Contagious Foot and Mouth Disease," while two others said it was "Ergotism" and a fourth that it was "Foot-rot," which is an indefinite term for another malady of which we know nothing etiologically, except that it is contagious. Foot-rot also occurs in ergotism.

The description of these authors fully calls to mind the saying about the doctors disagreeing; in reality foot-rot, or necrosis of the extremities, is about the only thing they agreed upon. This is a characteristic of chronic ergotism, though denied by one of these authorities for animals, on account of a misquotation from an author whom I will soon quote. Speaking of the action of ergot in large and prolonged doses, in animals, Finlay Dun — "Veterinary Medicines" — says: "Gangrene of the extremities is not, however, so readily produced as in man. Mules fed on it (ergot) lose their hoofs, and fowls lay eggs without shells."

It is especially to be noticed that even those veterinarians that looked upon the Kansas trouble as ergotism, do not mention a single case of abortion as having occurred, nor do they appear to have had a suspicion of it.

Concerning the power of ergot to induce abortion, Dun says: "Amongst the lower animals it certainly has no power of producing abortions. It has been given in large and repeated doses to cows, bitches, cats and swine in all stages of pregnancy, but without causing abortion."

In human medicine its abortive action is by no means general, and has often been denied, though it is known that it will stimulate uterine contractions in woman, when once begun. That it can cause them is very doubtful, though some vivisectional experiences would seem to indicate that they may occasionally result as deuterotoxic phenomena.

Having thus endeavored to call all the attention necessary to these collateral etiological momenta, it now becomes our duty to consider, or rather discuss, the evidence still further of what is considered to be *the cause* of enzoötic abortion in cows.

There can scarcely be any doubt that it is an infectious material, but a still more important question is, is it also of a contagious nature? If strictly infectious, but non-contagious, then it becomes domiciled in a locality — stable — all the cows being exposed to its action. If non-contagious, yet occurring in most of them, then *they* must have all been in a susceptible, or receptive condition to its action. Again, if not contagious, it would seem that this susceptibility to infection increased with the increasing days of pregnancy from the second or third month to the eighth.

For a disease to be contagious, it is necessary that the contagious elements multiply, or accumulate in an animal organism, and then cause infection of other animals by means of the excretions, expired air, or other organic derivatives from the diseased organism, as in glanders, small-pox.

We have also a mixed class of infectio-contagious diseases, which are rather uncertain in their infectious outlines.

I *think* this trouble belongs to the latter class; time and experiment only can settle the question. It seems to me that we have to do with infectious elements which develop in special places, from at present unknown causes. If not, how are we to account for the first case in a stable, where no cases have occurred, and no new changes in the cattle made, under the same hygienic-dietetic conditions that have always existed?

This may be *all theory*, but it is only by reflecting and carefully weighing all the evidence that we can find a way to proceed in the search after the cause. Then, the evidence of practical observation, supported, as I shall show, by some experiments, is *that it is capable of extending from cow to cow in a stable where it once gains entrance.* This would make it contagious. Only the most exact and experimental scientific differentiation, based on months of study and observation, can ever hope to elucidate questions of this nature.

Dr. Salmon, Massachusetts Agricultural Report, 1883, gives evidence of its mixed nature and of the preventive value of disinfection. Brauer (German) caused the trouble to cease after cleansing and disinfecting infected stables. He caused a pregnant cow to abort in nine days after injecting into her vagina some of the lochial discharge from a cow that had previously aborted. Similar results followed in 12, 15 (twice), 21 and 11 days in a corresponding number of cases from the use of the same material.

Lehnhert, also, speaks equally well of disinfection, etc., and has produced the same results by experiment with the same material in two cows at the seventh month of gravidity, abortion resulting in eighteen and twenty days, respectively. He recommends the speediest possible removal of the afterbirth, with the immediate and repeated disinfection of the birth-passages, and the immediate removal of the other pregnant cows from the stable.

Roloff thinks it due to some infectious miasma which enters per vagina to the uterus. He reports seeing the vulva and vagina swollen and injected in such cows anticipatory to abortion. Disinfection is valuable and the only means of prevention.

Franck * has similar views and has performed similar experiments to Brauer's with like results. The reports discovering a peculiar bacterial growth, Leptothrix, on the vaginal walls in such cows, which greatly increased in quantity until abortion took place.

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* Late director Bavarian Veterinary School at Munich.

A few personal experiences speak for the value of cleanliness, disinfection and isolation as an almost sure means to prevent the generalization of this trouble over the pregnant cows of a herd.

We have read the evidence. What conclusions must we draw?

1st. That we have to do with a very difficult task, which empirical observation can never solve, and which therefore requires the best scientific ability which the State can command; ability is necessary even if foreign to the State.

2d. Being a general evil it is the duty of the State to undertake the work of discovering its true cause.

3d. Experiments with ergot or ergotized material should be carried on.

4th. The nature of the cause. How does it originate? What is the character of its action, infectious, contagious or mixed?

5th. Even though micro-organisms may be, and probably are the cause, we must warn against any one being too sanguine as to their successful isolation and cultivation. The cow's vagina will be found plentifully supplied at all times with representatives of varieties enough to satisfy any one on account of the loose oppositional contact of the vulvo-vaginal walls.

6th. Can other septic material, such as decayed meat suspended in water, cause abortion in pregnant cows at the seventh month of pregnancy, which seems to be the period to select for experimentation. The same should be tried by vaginal injections with the ordinary filth and refuse of the stable-manure and urine.

7th. These materials, as well as the lochial discharges from aborted cows, should be tried upon pregnant mares, sheep, dogs, swine, etc.

8th. The lochial discharge from non-aborted cattle should also be tried upon such as have been known to have aborted at the previous pregnancy.

9th. Does the condition of the mouth and neck of the womb favor parasitic immigration into its cavity.

10th. What are the conditions of the fœtus and fœtal membrane at such times, with reference to germs, pathological changes, etc.? To this end several cows would have to be killed the moment abortive symptoms were visible.

11th. Every form of available statistics on open questions must be sceptically collected.

12th. The State will have to supply a farm and the means to buy cattle, feed and take care of them, as well as other necessary expenses.

One thing which should not be lost sight of is, that if such work as this is well organized and thoroughly carried out, it would be easily possible to gather the most complete statistical record of the health of our food-producing animals in Massachusetts, that has ever appeared in the country.

Tuberculosis in cattle should certainly not be forgotten.

The entire veterinary profession should be obliged to contribute their mite, especially the country practitioners.

I must most emphatically enter a protest against a "cattle commission" for any such work.

The best and most ultra-scientific veterinarian the State can procure should have the charge of the work, but should do it under the auspices and control of the State Board of Agriculture.

Mixed commissions of one or two ordinary technical men and several civilians are of no value for scientific work.

To get a good result the work must be first well planned and the entire forces working must be stimulated with one purpose and controlled by one power; the State is more liable to do herself credit by adopting the above plan than by any other.

The Chairman. We will now hear a few words from Mr. Bowditch. I shall not then invite discussion, for the reason that there is no man in this hall who knows anything about it, and a general discussion might be interminable and might not elicit any information. I will say, however, that there is already in existence a commission appointed by the Governor, of which Professor Stockbridge and Dr. Thayer of Newton are members. Those gentlemen are seeking information on the subject, and if there is any one here who knows anything about it or has had any experience in it, the commission would be very glad to hear from him, and would communicate to him the points upon which they desire information.

Mr. T. S. **Gold**, Secretary of the Connecticut State Board of Agriculture. Allow me to take exception to your statement, Mr. Chairman, that there is not anybody here who knows anything about this subject. I do not profess to be able to give the cause or the remedy for it, but I think I know something about it from personal experience on my own farm. I do know some facts that perhaps may be interesting, and if you will allow me three or five minutes to state some of them, I will do so.

I knew a case in eastern Connecticut, upon one of the best stock farms, where a cow aborted in a distant stable on the farm. She was brought into the home barn and placed there by the side of other pregnant cows. Abortion of the adjoining cow soon followed, and it spread in that stable until perhaps fifty per cent. of the pregnant cows aborted.

A cow from New York State was placed in Fairfield County for pasturage during the summer. There was some abortion on that farm. She was served by a bull on that farm, and in the autumn she was taken back to New York, and during that period of pregnancy when they were most likely to abort, and when the cattle on the farm where she had been kept during the summer aborted, this cow also aborted in her New York quarters.

Some years ago it was very prevalent to the west of us along the line of the Harlem road, over the mountains separating that section from the portion of Litchfield County in which I reside. I have had fifty calves a year for forty years, and with a single exception of a brief period, to which I will allude, I have not lost five calves in that forty years; but there was a neighborhood in our town of small dairies where abortion was prevailing. My neighbor pastured his young stock there and they began to abort. He brought them home and abortion spread through his herd. His farm adjoins mine at a distance of half a mile, only separated by a fence; but the herds never got together. One-half of his herd aborted that year. The next July my cows began to abort. The first animals were taken, thoroughly disinfected, turned away from the dairy, shut up by themselves, and fattened for the butcher, every one, until it became too much of a job to carry through. Then I allowed them to remain in the dairy and to take the bull after a considerable period. Abortion continued in my herd for about two years, taking nearly fifty per cent. of my calves, when it left me as suddenly as it came. It left me at the period when the services of a certain bull ceased. I had had two bulls and had abortions from the calves of both bulls, but still, when the service of this one bull ceased there was no more abortion on my farm and it has disappeared from the neighborhood. It did not pass from my land on to the adjoining farm. I have retained the same cows; they are all of home breeding.

These are all the facts that I have. I leave you to draw your own conclusions about them. We think there is more than one way by which it spreads, and we have strong suspicions that the male is as important a factor in it as the female, and even more so.

Mr. A. Bradley of Lee. I would like to inquire if we have reason to expect that abortion will continue more than one or two years? That is, if it comes into my herd and exists there this year, have I reason to expect a continuation year after year, or does it disappear after one or two years?

Mr. Gold. There are no facts that have come within my knowledge that would enable me to answer that question.

Mr. J. L. Cragin of Athol. I would like to ask if your bull served cows in other herds among your neighbors that did not abort?

Mr. Gold. He was confined to my own stock.

Mr. Garfield. I would inquire if it is known whether or not the cows that run on large ranges, or on the western prairies, abort.

Secretary Russell. The paper states that there has been no complaint made from the cattle ranges in regard to it, but anybody who knows anything about the manner in which cattle are looked after on the ranges would never look to them for facts. They know very little about the cattle they have in charge.

Mr. Russell of Great Barrington. I rise to support the position that the chairman has taken in regard to the discussion of this matter. Certainly I feel as much interest as any man in this subject; but it is one upon which we all desire to know simply the cause and the remedy, and there is not one of us who assumes to be able to give the cause or the remedy; therefore, it would simply become a discussion of illustrations. I rise to suggest that we go on with the business of the meeting and forego our interest in this subject, about which we shall not be any wiser, perhaps, after hours of discussion, and shall have lost valuable time which might have been devoted to those subjects which come in their regular order.

The Chairman. Many of us know of the existence of abortion, and that is the extent of our knowledge. We will hear Mr. Bowditch in conclusion of the subject.

Mr. Bowditch. A good many years ago I had a great deal of experience with this trouble, and I found the only thing to be done was to stop its going through my herd. At that time it affected a very large proportion of my cows; and from accident or some other cause I have had two or three cases a year out of fifty or sixty breeding cows. My plan has been to watch my cattle carefully every day, and I never in any instance allow a cow that has aborted to be brought into the presence of other pregnant cows. It can be guarded against by careful watching. There are certain symptoms which always come and you can tell them. You will notice them as quickly in a heifer that has never had a calf as in a cow that is giving milk. The symptoms are a swelling of the cord on each side of the tail and a sudden springing of the bag. You will see a heifer suddenly develop a bag, and if that comes accompanied with swelling, especially a swelling of the cord on each side of the tail, she ought to be at once isolated. Mr. Gold has made the statement that a cow that had aborted was brought back into his barn, and then the rest of the herd aborted. That may happen if the cow is not isolated long enough. You can isolate if you have a barn far enough away from your main barn, but the isolation must be perfect. The man who takes care of that cow should never be allowed to come near a pregnant animal, under any circumstances. I have a farm barn a quarter of a mile away, and the man who takes care of a cow suffering from abortion is not allowed inside my cow barn. I tried an experiment with a cow that aborted very early. Apparently there was no placenta; there was no discharge afterwards; everything was very clean. I brought her to my cow barn, thinking it was perfectly safe, and the cow that stood next to her aborted in three days. I now make it a rule to keep a cow that has once suffered away three months or longer, if there is any sign of discharge. I do not know how we can account for this contagion, unless it is through the smell entirely. I had a cow that was in the quarantine barn from lameness; a heifer that was there aborted, and within an hour from the time the heifer dropped her dead calf this old cow made a sniff, began to bellow, and in three-quarters of an hour she cast her calf.

In regard to the treatment of the animals after they have aborted, it is necessary, as the paper states, that the afterbirth should be removed at once, or within twenty-four hours. It must be done very carefully, because the afterbirth is not ready to come away. It must be done thoroughly, and the parts kept perfectly clean; and the cow should not be allowed the service of the bull for six or seven months — perhaps longer is better; and then it is a difficult matter always to make her breed. I have tried a variety of experiments in that way latterly, and I think I have discovered one reason for the difficulty. After abortion, the neck of the womb is very apt to get displaced; instead of being in the regular position, it is very apt to be a little dropped, a little curved, so that the bull fails to make his proper connection. Two or three years ago I tried to remedy this difficulty once or twice unsuccessfully. This year I have had three or four cases of abortion, and one was the case of a cow that I had been coupling quite carefully for nearly two years. The operation consists in straightening the neck of the womb and opening it. After the neck of the womb has been held in place for an instant, the cow is led out at once to the bull.

Mr. C. D. Benedict of Holyoke. I would like to know if the gentleman has ever known a heifer or cow to go by after showing these indications?

Mr. Bowditch. Rarely. If you see the indications and can discover a live calf, you may save it. I think on one or two occasions when I have seen strong indications, I have helped the cow to carry her calf by keeping her very quiet. A sudden fright will produce abortion as quickly as anything else. If you see that the calf is alive, keep the cow perfectly quiet with doses of laudanum. Keep her nerves as quiet as possible and you may save the calf.

Mr. Benedict. About what percentage can you save in that way?

Mr. Bowditch. I don't think you can reduce it to a percentage. I have saved one or two.

FOREST TREE PLANTING.

BY AVERY P. SLADE OF SOMERSET.

Planting forest trees on our worn-out lands is done to a limited extent, but the matter does not receive that attention which its importance demands. The interest so recently awakened in the public mind in regard to the destruction of our forests may be regarded as a sufficient apology for calling your attention to the subject at this time.

Some one has estimated that no less than 100,000 acres of wood and timber must be cleared *daily* to supply the demand for fuel, and for the various industries of the country, to say nothing of the vast amount that is annually destroyed by fire and decay. This demand would necessitate the yearly cutting of 31,200,000 acres, or an area somewhat larger than the State of New York. From this fact, we are enabled to judge, approximately, of the rapidity with which our forests are disappearing. If the removal of the forests changes the meteorological conditions of a country, or if the amount of rainfall in a given territory is in some degree proportional to the area covered by forest, then the subject assumes an importance which cannot well be overrated. A law of Prussia required that for every tree felled two should be planted. While our Legislature is powerless to stay the axe of the woodman, it might do much to encourage the planting of forest trees, and thus to some extent mitigate the evils which must surely follow their final, or even their partial, destruction. Pasturing exhausted soils, or cropping them with rye, yields but a poor return; and nothing has a more demoralizing effect on an agricultural community than the cultivation of large areas with small profits. There are thousands of acres in Massachusetts which really yield no profit to the cultivator, but which, if planted to white pines at trifling expense, would not only pay a reasonable rate of interest on the investment, but would speedily convert the large areas of unproductive land in Eastern Massachusetts into delightful groves, adding a positive beauty to the landscape and a source of wealth to the community. I have spoken often of the white pine (*pinus strobus*), because I regard it best adapted to our climate and to the soil of the most of our waste lands. A soil in which the white oak flourishes will produce grass, and a soil that suits the chestnut will grow grain; but the white pine not only grows rapidly on land which is apparently nearly destitute of plant food, but it actually enriches the soil on which it grows.

While I am aware that this tree cannot be successfully grown on lands near the seaboard, I would urge the substitution of some variety better suited to the soil and climate. The pitch pine (*pinus rigida*), which seems to struggle for existence on the seacoast is of slow growth, and produces a wood which is of little value, except for fuel; and he who shall substitute a hardy tree of rapid growth to take its place will be regarded as a public benefactor. The softer woods, whose fibre is susceptible of being reduced to a pulp and rolled into paper, may prove as valuable to the next generation as the oak has to the present. Iron has already supplanted the oak in marine architecture, and paper may yet take the place of both. To encourage any enterprise, we have only to show that it is safe and profitable. We therefore propose to examine this subject in the light of an investment. So far as any experiment has been tried, coming within the circle of my knowledge, the result has proved eminently satisfactory. Although in many instances pines have been planted because the land would produce nothnothing else, — and often for the purpose of gratifying the taste by covering a rocky hillside or sandy plain, and not with a view to profit, — and though rarely, if ever, receiving any culture after planting, yet in no instance that I have investigated has it failed to be a paying investment. Mr. Zebulon

Pratt of Bridgewater purchased 25 acres of worn-out land in North Middleborough, near the village of Titicut, for which he paid $9 per acre. Having a desire, as he says, to improve the view, and to learn the result from a moderate outlay, not anticipating a profit, in the spring of 1863 he had it set to white pines, at an expense of $6 per acre. Two years after, he paid a man $47 to fill up the vacancies, where some had died, making the whole cost of setting $200. The plants were from 6 inches to 18 inches in height, and were set in straight rows 10 feet by 10 each way. Last December, in answer to some inquiries, Mr. Pratt wrote that they were from 12 to 16 inches in diameter, in a thrifty condition, and that he has, from time to time, been awarded premiums from the Plymouth County Agricultural Society for the best plantation of pines. The lot is taxed for $800, which is based on a two-thirds valuation; and as towns are inclined to favor experiments of this kind, it is fair to presume that the assessor's valuation is not too high, and that the cash value of the lot is not far from $1,200. Comparing this with the outlay, we have —

Cost of land, ...	$225 00
Setting trees, ...	195 00
Taxes for 20 years, ...	120 00
Aggregating	$540 00

— which sum, in 20 years, at 5 per cent. compound interest, amounts to $1,431, or $231 more than its supposed value. But Mr. Pratt says that he did not embark in this enterprise for a profit, but to benefit the inhabitants of the village, and that he might be remembered pleasantly by those coming after him. Had he planted this grove with a sole view to profit, he would undoubtedly have put them 10 feet by 6, instead of 10 feet by 10, thus having 726 to the acre instead of 425. It is generally conceded that pines standing 6 feet by 10 will make a growth of more value than when planted at a greater distance apart. When planted 10 feet by 10 there is a greater growth of limbs, which are of little value, and less growth of trunk than when planted nearer. Now, if 425 trees to the acre brings the value of the lot up to $1,200, then 726 trees to the acre would be worth the round sum of $2,000, which is $272 more than the whole outlay would have amounted to at 6 per cent. compound interest for 20 years. After receiving Mr. Pratt's letter in answer to my inquiries, I visited the lot and examined it. The plantation covers a sterile ridge, consisting of sand and gravelly loam, sloping east and west, and evidently well suited to the growth of white pines. So far as my examination extended, I could discern no vacancies in the rows caused by dead trees. But the discovery which surprised me most was the number and extent of the lateral branches. Beginning near the ground, each tree seemed to vie with its neighbor in throwing out horizontal branches in every direction, corresponding with every point of the compass. These limbs were from 5 to 15 feet in length, interlaced with each other in all imaginable ways, and forming absolutely, in many places, an impenetrable tangle. The conviction was irresistible that had these trees been properly trimmed, from time to time (and the wood would have paid the expense), their present value would have been enhanced at least 33 per cent. Here were said to be 10,775 trees, and could the whole growth have been thrown into the trunk, they would at a moderate estimate, I think, have been worth at least 25 cents apiece, or a sum total of $2,694 exclusive of the land they stand on. Mr. J. D. G. Williams of Raynham, in answer to some inquiries, says that he set a piece of land with pines in 1850; the value of the land was $10 per acre, and the cost of setting was $5 per acre, and after 25 years' growth the standing wood was sold to Mr. Thayer of Taunton for $150 per acre, leaving the land, as he says, in good order to set again. A very large profit on this investment is too apparent to need a demonstration. Mr. Williams also set a piece of pine, in 1841, on land of the same value, the cost of setting being $6 per acre. This is, perhaps, one of the oldest or earliest experiments of the kind made in Bristol County. These trees apparently came to maturity in 1876, as no perceptible growth has been observed since that time. They were set in rows, not equidistant from each other, but varying from 6 to 9 feet and from 4 to 6 feet in the rows. A portion of this piece is still standing and attracts more or less attention. The lot has an eastern exposure. and the trees on the east side, in the first row, were evidently set for a wind-break, they being not more than four feet from each other. They are large, with many strong, angular branches, resembling oaks in form rather than pines, and containing as much timber as those less exposed, but not of so good a quality. This lot was examined, in 1876, by an experienced lumber man, with a view to buying it; his estimate of the wood at that time was 75 cords to the acre. About two-thirds of this wood, or timber, is suitable for box-boards, worth at the mill, three miles distant, six dollars per cord. No arithmetical process is required to show this to be a profitable investment. The late Mr. Richard Sampson of Middleborough set pines on land too poor to cultivate, which are now 31 years old, and the wood is now estimated to be worth $150 per acre; and if the worth of an article is what it will bring in market, a much higher figure would better represent its value. This piece, which contains about ten acres, is remarkably thrifty, and its growth during the next decade will greatly increase its value. The groves of which we have spoken may well be styled self-made groves. Excepting the occasional removal of a dead tree, they have received no treatment calculated to hasten their growth or improve the quality of the timber.

One noticeable feature in all the groves I have examined is a want of uniformity in the size of the trees; though all are nearly equal in height, yet they vary in diameter from 10 to 20 inches. Occasionally we find a tree of the smallest size, which has struggled for equality from 10 to 20 years, when it is overpowered by its big and thrifty neighbors, while the largest trees appear to live out all their days and die of old age. The foregoing instances of rapid growth and satisfactory results are not exceptional cases, they were selected because I was better able to get the items relating to their history more in detail than I could of other groves. Plantations of pines from 5 to 30 years of age may be found in Norton, Mansfield, Taunton, Raynham, eastern Randolph, Middleborough and the Bridgewaters, all giving promise of remunerative results. In investigating this subject I have been somewhat perplexed at the wide range of opinion found to exist in regard to the details of pine culture. One gentleman says that they should not stand nearer than 10 feet to each other, and should occasionally be trimmed, while his neighbor asserts they should be planted very thickly, letting nature do the trimming, and the fittest survive ; others say that artificial trimming frequently kills the tree, and always causes an oozing of the gum or sap, causing dark spots in the lumber, which the tree will never outgrow. If the limbs are allowed to fall from natural causes, the wounds, if any remain, quickly heal, and lumber of a better quality is the result. One lumber man asserts that if the tree is trimmed when the sap is dormant no injurious effect will follow, while his partner advised me, in a sort of confidential manner, that if the trimming is done when the sap is in motion the wounds will quickly heal without injury to the tree. "Who shall decide when doctors disagree." A difference of opinion, also, is found to exist in regard to the age at which the pine should be cut to yield the greatest profit. A gentleman of my acquaintance, in whom I place great reliance, having a grove 31 years old, found by careful experiment that the growth of the last ten years equalled that of the first twenty. A point, I am happy to say, on which all agree, is that the young seedling pines should be carefully sorted before setting, and those uniform in size and vigor should be set together. I would plough the land in the fall, and set the following spring. I would carefully assort the plants and set those of the same size together, 10 feet by 8, using 543 seedlings to the acre. I would run a cultivator between the rows twice a year, until the plants become well rooted and attain the height of three or four feet. I would, also, with a sharp knife, cut off one or two of the lower lateral branches or shoots, always cutting upward, so that the bark on the under side would not be stripped from the trunk ; this I would do annually so long as any branches remained within my reach. By ploughing I should secure to the soil whatever organic matter in the shape of moss or grass might lie on the surface, and by using the cultivator I should destroy or greatly discourage any plant that might presume to subsist on the scanty food of my seedling, and at the same time enlarge the absorbing power of the soil and thus furnish a greater amount of moisture, so essential to the thrift of a young tree in the early stages of its growth. By early and judicious pruning I would throw the growth into the trunk, and gradually accustom its smooth and tender bark to resist the effects of the sun's rays, which nature evidently designs to shield by a profusion of lateral branches. This mode of culture would reduce to a minimum the risk of loss by fire. By carefully assorting my trees, I would found my colony on a basis of equality, putting the seedlings of the same size and vigor together, and thus giving them an equal chance in the race of life with their stronger comrades and avoiding that inequality in size which detracts so much from the beauty of the grove. The treatment above outlined might be profitably varied, if desirable, by sowing broadcast between the rows the seed of the white birch (*populifolia*). This should be done when the pines are 4 or 5 years old. Being the only deciduous tree which is known to flourish best where the land is poorest, they would soon overtake the pines, and by their dense and rapid growth would so check their laterals that pruning would be unnecessary. At the end of 12 or 14 years they should be cut, when they would probably yield as many cords per acre as they were years old. A natural growth of birch would follow their removal, which would mature with the pines. Eminent medical authority assures us that where pines are grown to any considerable extent, the atmosphere becomes saturated with a sort of resinous vapor peculiarly adapted to soothe and alleviate the sufferings attendant on pulmonary complaints.

Thus far we have spoken chiefly of the white pine, because it is well adapted to worn-out sandy soils, away from the seashore; but experiments are not wanting where a variety of forest trees have been grown from seed, giving satisfactory results. That of Mr. Zachariah Allen of Providence, R. I., where an old pasture containing 40 acres, and valued at $15 per acre, was seeded to a variety of forest trees, and an accurate account current kept with the lot for a period of 57 years, paid $6\frac{92}{100}$ per cent. per annum on the original investment. Mr. Joseph S. Fay of Wood's Holl, late member of the Board of Agriculture, has briefly but very kindly given me some of his experience in forest-tree planting, which I propose to read. He says: —

"The greater part of a place I bought at Wood's Holl some years ago, was made up of hilly pasture land, worn-out, sandy, gravelly soil, with many boulders. It was exposed to high winds from Buzzard's Bay, and of very little value for cultivation. I began by trying some seed of the native pitch pine, sowing it broadcast on the surface in the spring. I afterward bought some seed of the Scotch pine, and some other varieties, and sowed them from time to time until I covered about 100 acres. I used some white-pine seed; but this kind is not suitable to the seashore, and unless sheltered from the salt water does not thrive. The native pitch pine did well, but seems of late to be taken with a blight that has destroyed many of them. The Scotch pines have done very well; though I am doubtful as to their value as timber, yet they will make good fuel. I suppose my planting for the last 15 years will average 15 feet in height, which is one foot a year, and a thick forest now covers my hundred acres. By sowing broadcast they have come up too thick, and I have trimmed out hundreds of loads for fuel, and yet they are hardly missed. My neighbors on the Cape plant with a hoe; that is, cut a place in the sod and drop the seed. Others run light furrows, six or seven feet apart, and drop the seed the same distance. Cover lightly or not, as you may judge by mine being scattered on the short grass or moss. The object in planting this way is the saving of seed, and knowing where the seed was dropped, you can see if it has failed to come up. Some of the seeds may not start or be visible for a year or two. Where you are, I suppose white pine is natural, and would do well. Seeds of the pines can be procured at most of the Boston seed stores. I would recommend the American red pine (*pinus resinosa*), but the seed is very scarce and not readily found. It is the Norway pine of New Hampshire, and a very fine and valuable variety, — the wood something like the southern yellow pine. You will see from what I have written that my work has mainly been in pines grown from seed sown broadcast, involving the least possible labor and expense. I have planted chestnuts which have made a very satisfactory growth, and would advise planting them and black walnut, if you have good soil and rocky land. I have planted many thousands of other varieties, covering a large surface, among which are the Scotch or European larch, Scotch birch, English sycamore, Norway spruce and willow, and white ash, all have done well. In sowing pine seed broadcast, improve the time after a light snow, in March or April, so that you can see where the seed falls, that the planting may be uniform and not too thick. If the land is not too poor, black walnuts, butternuts, and especially chestnuts, planted from the seed, I am sure would prove a profitable investment. The seedling ash, if planted three feet by three, even in a few years would yield salable hoop-poles, amply paying cost and interest."

The foregoing statement plainly shows what has been done, in a quiet way, involving but little labor and expense, by one having the will and energy to do it. Mr. Frederick Matthews of Yarmouthport has, during the last forty years, planted for himself and neighbors about 300 acres of pitch pine. This tree is of slow growth, and yet some of the oldest plantations seeded by Mr. Matthews reached, years ago, a stage in their growth when it was deemed profitable to cut them for fuel; and he is now cutting wood for his own use, in a grove planted only thirty years ago. He has within a few years noticed a blight which has proved fatal in many cases. This blight, and that noticed by Mr. Fay, is without doubt caused by the pine moth of Nantucket (*retinia frustrana*). He gathers the cones in October, and after thorough drying for two months, shells and cleans the seed, and plants in the spring with a machine of his own construction. He thinks it pays a moderate interest on the investments, and is acquainted with no other tree as well adapted to the soil and climate of Cape Cod, or that could take the place of the pitch pine. This tree, as we have remarked, is of slow growth, even under favorable circumstances, and that growth is retarded as you approach the seashore, until, face to face with the ocean, it is so slow that a careful observer can scarcely see any change from year to year. This is a discouraging fact; and he who would dot the sea-coast with groves, knows, perhaps, of no variety that will root itself in the moving sand and flourish in defiance of the ocean gales.

Observation and somewhat extended inquiries strongly favor the belief that there is no tree so well adapted to take the place of the pitch pine, and to cover the loose, sandy areas of our coast, as the once noted ailanthus (*ailanthus glandulosa*). Being aware of the prejudices existing against this tree, inherited chiefly from a former generation, let us examine its merits and render a verdict in accordance with the facts. The ailanthus is a deciduous tree and, we are told, is abundant in the northern provinces of China, and is indigenous to that country. In 1750 it was introduced into Europe as an ornamental tree, and about 1820 was planted in the United States. From its rapid growth and tropical appearance it soon became a favorite, and was planted extensively in the cities of New York, Philadelphia, Providence and Newport, and the demand for the young trees far exceeded the supply. As soon as the trees were old enough to produce flowers, it was discovered that they emitted a very offensive odor, and the pollen which fell on the roofs of neighboring houses rendered the water falling on those roofs unfit for drinking or culinary purposes. On discovering these objectionable features in its character, those who had cherished this rare exotic were suddenly seized with a feeling of disgust, and war was declared against the offending ailanthus, resulting in almost its complete extermination. A few may be found scattered over Rhode Island, and in some of the villages of New England, lineal descendants of a despised and persecuted generation. The objection to the ailanthus, which operated so swiftly to bring it into disrepute, disappears quite as swiftly when regarded in the light of a forest tree. The wood possesses many valuable qualities. Its specific gravity is said to be but little less than that of the oak, and more than that of the black walnut. It is of a pale cream color in appearance, admits of high polish, seasons readily without checking, and is a strong, durable wood when protected from the weather. Prof. Sargent, in his Notes on Trees and Tree Planting (a paper read before the Massachusetts Board of Agriculture in 1877), and to whom I am indebted for much valuable information relating to the ailanthus, says: —

"There are thousands of acres of shifting sand and barren soil, along our sea-coast southward, too poor and too exposed to produce naturally anything but a scanty crop of beach grass, on which the ailanthus would thrive, and which, thus covered, would add enormously to the natural products of the country. Such plantations would amply and speedily repay the original cost, both in direct income and by the protection it would afford to more valuable land. Valuable timber for purposes of construction might not grow on soil so poor and exposed; but immense quantities of fuel, easily accessible to market, would be produced from land now worse than useless to its owners. On almost every inland farm there is some neglected gravel-pit, or bank or knoll, too stony and poor for cultivation, which might be profitably planted with the ailanthus; and these plantations would provide in a dozen years, more or less, a large amount of valuable fuel, and might be cut, and cut over again, indefinitely, as there seems to be no limit to the powers of this tree to throw up suckers from the roots. Or if permitted to grow from twenty to forty years, such plantations, costing but little to make, and occupying land good for no purpose but to pay taxes on, would produce a valuable material for industrial purposes, for which a ready sale at good prices could always be obtained."

Mr. George P. Marsh, in an allusion to the efforts of the Russian government to cover with forest growth the northern coast of the Black Sea, where the loose, sandy soil, to the depth of a foot, is moved with every changing wind, says: "The tree best suited to this locality, and there is good reason to suppose to sandy plains in general, is the ailanthus grandulosa."

With such testimony it is certainly safe to give the tree a fair trial. There is no soil so poor and no situation so exposed where it will not grow. It is as easily propagated as the blackberry; a piece of the root the size of your finger, when set, will produce a plant, and the seed, whether scattered on the surface or covered with soil, will quickly germinate. One objection to the ailanthus as an ornamental tree was its tendency to throw up suckers from its roots, and thus reproduce itself without limit, a positive virtue when wanted as a forest tree; and, unlike the oaks and pines, it increases in size most rapidly during its earliest years. The perfect adaptation of the ailanthus to the localities mentioned may be justly regarded as an evidence of design in the origin of varieties. In view of the foregoing facts, which we admit have been imperfectly presented, it is not easy to account for the general apathy which is found to exist on this important subject. Capitalists are eagerly seeking permanent investments which promise three or four per cent. per annum, while the industry we encourage pays a better dividend and in every instance has proved a financial success. One of the motives which prompted Mr. Pratt to plant his grove, he says, was that he might be remembered pleasantly by those coming after him. To this must be added the genuine satisfaction of having contributed to increase the country's wealth, and at the same time clothe the sterile hillside with verdure and cause the barren plain to bloom and blossom as the rose; this of itself is indeed a dividend which, though not going directly to swell the bank account, possesses a value, nevertheless, not easily overrated.

The CHAIRMAN. The subject presented is a very interesting one, and from what I have heard I am inclined to think that Col. Wilson of Boston can give us some further ideas on this subject. We shall be very glad to hear from him.

Col. HENRY W. WILSON. Mr. Chairman, — The subject of forest planting is one that cannot be too much encouraged among the agriculturists in this part of the country. My business, as might be inferred from my talk yesterday, has been largely to deal with dirty water; but I started out with the study of pure water, and for a number of years that was my business exclusively — pure water and how to get it. I soon found that that subject ran into forestry naturally, as the purest, sweetest and most natural source and storage for pure water is the forest; and ultimately, and I think within my lifetime, the source to which our metropolitan district will have to look for pure water will be this subject of forestry. But you cannot make twenty-five men in Boston believe it, or see it, or understand it to-day.

In one of the richest counties of this State I will drive you, in one afternoon, by eight or nine abandoned farms, and we will not go out of our way to find them, either. That is in the county of Worcester, which is distinguished for the productiveness of her farms. Those lands bear little that is of any practical utility to man to-day. I do not think I ever saw so mournful a picture in my life as the sight of those old houses, dilapidated and abandoned, the windows boarded up, in some cases the chimneys torn down, the walls and fences all gone to rack and ruin, and all the surroundings a very picture of desolation. And that in Worcester County! The owners of those lands would be glad to sell them for two dollars and a half or three dollars an acre. There is your foundation, and there is your plant. There is not an acre of those farms that could not be brought productively into forestry, made profitable as an investment, and add to the wealth of the community and the income of the owner.

How is it to be done? The foundation of it is preparation of the soil. The farmer who sets out a tree, who thinks it is nothing but a forest tree, a cheap thing, and who grudges his labor, who goes with a spade or a hoe, digs a hole, and rams the roots in as solid as if he was driving the wad into a gun, will be very apt to find that the tree will not live, and he will say: — "This whole thing is a humbug." It will pay to plough the land if you want to plant forest trees. It will pay to take out the rocks and stones and loosen the soil so as to give the new plant a chance to live.

Before you plant you want to determine what kind of tree you will grow. That depends upon the conditions of soil and climate. If possible, you want to select that sort of tree that the thinnings will be of value. Therefore, if the nature of your soil is such as to warrant the planting of white ash, white oak, hickory or elm, which are "wheelwright stock," so called, do so by all means, because their thinnings are vastly more valuable than the thinnings of other trees, and will pay your first expense, increase your sinking fund at the start, and insure you a profit. There are places where the white pine will do well, and certainly there are advantages in that. But the white pine, to get perfectly matured, to be of the greatest value, must be seasoned by age; it must grow and then mature. It has been determined that the black walnut and the white pine must not only mature their wood, but must have time for the heart wood to ripen, in order to become of the highest value. A black-walnut tree at the age of fifty years will have a certain value; at the age of a hundred years it will be five times more valuable, simply from age, which ripens the heart wood. That has been demonstrated beyond peradventure, and has been determined by the very highest authorities in forestry.

We will assume that we have selected a location that is fit for wheelwright stock. I do not care to raise lumber the highest use of which is for boxes. I do not care to engage in the lowest grades of labor. I do not believe that community is the wisest and best that encourages men to depend upon the pick and shovel solely for an income. Consequently, I would not raise timber for box boards when I can raise it to make pianofortes. Now, we will suppose that our soil is adapted to the raising of fine hardwoods. We want to plant the seeds. Do not buy your trees of the nurseryman; raise them yourselves. It is just as necessary for the perfect success of forestry that the trees should be planted in a nursery where they are to grow, as it is in any other thing; consequently, you want to start your nursery ahead. Don't sow your seed broadcast. Don't trust to luck for the seed to come up. Select your seed carefully and plant them as thickly as you would for orchard trees. After one or two years — one year is better — plant them out in the land you have prepared by ploughing and cultivating properly.

Now, as to planting. Men talk about setting out the trees ten feet apart. True, the matured trees ought to be ten or twenty feet apart; but what we want to get is trees up in the air, tall and straight; you do not want spreading pasture-trees. Consequently, they must be planted near together, in regular rows, so that they can be cultivated. The best success is attained by planting the trees from three to four feet apart, making a thicket of them. They will stretch upward for the sun and air and you will get a straight shaft in a short time.

The trees should be cultivated. They should be planted in rows, so that you can run a cultivator through them if necessary. It may be that the weeds will not trouble you; but the bushes and the rubbish that will come in must be cleaned out. You understand that these plants are young;

they are tender; they are struggling for life. You do not want any useless vegetation among them, and consequently the best labor you can expend on the plantation for the first two or three years is in cultivation. In five years you will have a good many tall, spindling trees, that will be useful for hoop-poles. Cut them out; take out each alternate row each way. Then you will have your rows five by eight feet apart, and you have got a lot of hoop-poles, worth from three to five cents apiece to sell, and you have quite a little income for your sinking fund; very likely, enough to pay for the entire outlay up to that point.

Those trees will continue to grow, and when they are ten or fifteen years old you have got good merchantable stock. Thin them out again. Then you have a forest abounding with tall, straight shafts, with no low branching limbs to diminish its value. Your forest is well established; you have got back the money you have invested, and you have found that it pays very directly to plant a forest.

I do not know that I ought to take any more time, because there must be somebody in this audience who has had experience in this thing. I suppose the best man who ever talked on this subject was Dr. Warder of Ohio, who unfortunately died last year and was a loss to this country. He was an enthusiast, but he was a practical cultivator and raised trees not only for amusement but for profit, and there did not seem to be any question in the whole range of that business that he was not ready to answer from his experience. I had a good many of my best points from him, and if I had dreamed of occupying this position to-day, I would have put into my bag some of the valuable principles and remarks that I have heard him utter. But I will say further, that it will pay you, if you raise any hardwood for your fires, to raise hickory. It is a great deal better to sell for cord-wood than poorer qualities of wood, and we are always trying to get the best hardwood to burn that we can. Or you can raise good maple wood on some stray corner of the farm, for use on your own kitchen fires. I do not know how many of the people who listen to me can tell when a maple tree drops its seed; but I do not find many men who have noticed that. Just for curiosity I would like to have every one here who can tell, raise his hand. (Three hands were lifted.) There are three men in this company of intelligent, representative men, who can tell what time to get maple seed. I have seen a handsome maple that was raised from seed sown the same year, showing how rapidly a plantation of healthy, vigorous maple trees might be established. The seed could be gathered in June and be immediately sprouted. If left to nature they will not get proper food and proper growth of themselves so well as by being cultivated; but if the seeds are gathered and planted in a little nursery, by autumn you will have a splendid lot of thrifty trees to transplant the next year in a properly prepared place, and in a very few years you will have an abundance of wood that will pay you for firewood. The trees will have straight trunks to cut into cord-wood sticks, instead of the little, straggling trees which you get from your pastures ordinarily.

It has not been considered by the authorities wise to attempt to prune forest trees, because labor is too valuable and you cannot afford the time. The true process is to plant the trees thickly, when the feeble ones will be crushed out by the law of selection; and as the tree struggles up to get light and air, it grows straight and tall. If a tree begins to lose its leaves, depend upon it, it is starving and there is not nutriment enough in the soil to support it. Cut it down and you will give increased nutriment to the adjoining trees. You are not going to lose anything. It is better to have a small number of large trees than a larger number of puny trees. Therefore, if you see a tree which is evidently checked in its growth, instead of trying to save it cut it down, and you will get all the growth that the land will sustain in the remaining trees.

The CHAIRMAN. I am very sorry to interrupt, but we have other subjects on the programme that are of especial interest to the people here. We will now hear from Mr. Gold, the secretary of the Connecticut State Board of Agriculture.

PASTURES AND PASTURING.

BY T. S. GOLD, SECRETARY OF THE CONNECTICUT STATE BOARD OF AGRICULTURE.

In discussing this perplexing, knotty and well-worn topic, I must be allowed to draw largely from my personal observations, extending over a period of more than fifty years, and to ramble in discourse as we ramble in fact over the fields. We shall find that there are various causes for deterioration in our pastures, demanding different remedies in different cases; and successful examples of improvement will suggest plans, either simple or compound, upon which we may work to increase their productiveness.

If the discourse is dry, so are our pastures; if it is irregular, without form or order, so are our pastures; if it is choked and marred with weedy and out-of-place thoughts, so are our pastures infested with useless vegetation. Is the subject well worn and even barren of results? So are our pastures. Criticise it as you may, you will find a counterpart of its defects in the fields; and we venture to hope that the green oases of many a luxuriant field may also find a counterpart in some illustration or example, so that even so trite a subject may furnish us some instruction in dealing with what all admit to be one of the most serious problems in New England agriculture.

There is a general cry that our pastures in New England are running down; are less productive than formerly; and while this may be true as a general rule, there are so many and notable exceptions, that we need not accept it as a necessary result, but should be encouraged to use our efforts to make the improvement a general one — an advance along the whole line.

What shall be the Size of Our Pastures?

As far as dairy stock is concerned, the stock will undoubtedly do better to have their entire range in one or two pastures. Turning out reasonably early in the spring, with stock enough to keep the feed reasonably short and therefore fresh, will give the best returns for the dairy. Quietness in the cows is of as much importance as the feed. Cows, especially if home-bred, soon learn what their range is, and wonderfully adapt themselves to its productiveness. Our pastures are necessarily made up of some good land; but the major part is too rough, too poor, too wet or too dry, to admit of profitable cultivation; hence our object is to make the most of an almost valueless article by allowing stock to glean what it may produce. No wonder that, with this single object in view, such pastures should produce less from year to year, — should run down.

While the continual use of pastures for the dairy must exhaust them of their most valuable mineral elements, unless some means to prevent this are derived from outside sources, yet the location of the *lying-places* of the cattle, where they stay when not feeding, has much effect. I knew a large dairy farm, one of the most productive in the county of Litchfield fifty years ago, that had but two pastures, one for the day and the other for the night. The day range was the largest and the lying-place of the cows, near one corner, hardly exceeded two acres. The lay of the land and the channel of a brook cut this off from benefiting the rest of the field. The result was it grew poorer and poorer; hardhacks (*potentilla fruticosa*) got in, and have pretty much usurped the whole field. In the night pasture, somewhat less in extent, the lying-place was on a ridge where everything was saved to the field, and this pasture was more productive at the end than at the beginning. It got a little from the other larger field; but its smaller size caused it to be more closely grazed, so as to keep out foul stuff. It was also drier, so that the feed was naturally sweeter. But, after all, the lying-places of the cows had much to do with the loss of productiveness in one field and gain in the other. One good farmer laid so much stress on these lying-places, that he took pains to provide them in the parts of the pasture he desired to improve. He cut the coarse grass from the swales and made small stacks upon the dry knolls. A little later this would be spread about with a fork, and the cattle would lie there and their droppings be where they would do the most good.

Where cattle are salted they will often come. I have seen cows salted in the narrow lane leading to the milking-yard or barn. The time is well spent in carrying the salt to some part of the field where their droppings are needed. Many a coarse tuft of grass will be eaten when the appetite is sharpened with salt. Shade trees, also, largely control the place where cattle stay. If the only shade is down by the brook or spring, this will add to the other attractions, and the cattle will spend much time there. A few shade trees on the upper side of the field, not only conduce to the comfort and thrift of the stock, but keep the droppings where they will be saved. Milch cows, unless otherwise strongly influenced, will always lie about the bars, as some will have calves or are anxious for milking time. Fat cattle and young stock seek the most comfortable places for staying. Sheep seek the most elevated parts; never lie down in the swamp. This habit of the sheep is one considerable reason of their beneficial effect on pastures.

Young stock (as is also the case with dairy cows) will do better when but few are kept in one enclosure. Convenience demands the whole dairy herd to lie together; but with young stock, if water can be secured, some pains may be taken to keep them in small enclosures, as thus the fertility of the whole is more easily controlled, in addition to the improved thrift of the animals. A change of pastures is grateful to sheep; it seems to benefit them, and their help in sustaining the fertility and productiveness of the pastures is thereby enhanced. As some weeds are eradicated by sheep, so continual close pasturing by them will prevent some of the clovers and better grasses from seeding and they will run out. While we would not advise

Pasturing Cattle, Sheep and Horses Together,

yet much advantage is often gained by an interchange of pastures for a few weeks or for an entire season; as some weeds incline to multiply in cattle pastures, others in horse pastures, and still others in sheep pastures, especially if thus used for a term of years. I have two pastures that for ten years had been used only for horses. Golden-rod came in, almost unknown in adjoining cattle pastures, and threatened to cover the whole. This season the cows have had a partial occupancy and the golden-rod is mostly subdued. Horses and mules will eat and thrive on the rank growth of grass around the over-rich places in the cow pastures.

Sheep confined in a cow pasture infested with daisies, up to July 1, will clean them out in two consecutive years. I have done this with my worst-infested dairy pasture. No other remedy but sheep seems able, in an economical way, to cope with the wild carrot. Some few weeds are never eaten by any of our domesticated animals; but most weeds are eaten in greater or less degree by some of them. I have noticed that when any weed or shrub was very abundant in a field, animals would more generally refuse it and it would go uncropped, than where it existed as a straggler. Neat cattle will eat a few daisies or hardhacks, but abhor them as a sole diet.

While I would give my cows the entire range, in proportion to the size of the dairy, I know it is not ordinarily for the best good of the pastures. Some portions will be neglected, and the herbage become dry and hard and be of little service for the dairy. Cut off this part, if possible, and use it for dry cows or young stock. Many an outlying field has been restored to usefulness solely by confining stock there, so as to keep down the wild growth. I have in mind one field that kept two cows, turned in late in the spring, but poorly till July, and then they would be taken out. Nothing was done to it but putting in four cows early, and they had fair feed the whole season; this was a coarse, rough, wet lot. Another field, lying warm and dry, starting daisies and golden-rod early, would receive an apology for mowing in August. This labor was wasted. It did not check the weeds and the product was valueless. Turned to pasture for the last six years, and closely fed, it has wonderfully improved in appearance, and has yielded a fair rental on its value.

Close pasturing is a dangerous doctrine to teach, for apt scholars are ever ready to adopt it. Like a shorn lawn, a pasture never allowed to get up enough for a good bite will lose its better grasses. The roots will be very short, like the leaves, and the season's productiveness thereby diminished. But "wisdom is profitable to direct."

Poor fences have much to do with poor pastures. That is, the proper control of the pasturage in fields, so that they can be fed to the right degree at the proper time, forms an important element in their continued productiveness. The question whether we can afford to raise our own cows and oxen depends largely upon utilizing these outlying fields, which otherwise would go to waste; not only a waste of what they now produce, but a loss of their capacity to produce herbage that can be turned to some profit. Virtually, our summer pasturage on such fields costs less than maintaining the fences; for without it the land is growing less productive faster than with it, even if it does not grow better, as it usually does by proper use. If we add to this a dressing of plaster or ashes, and, where needed, a little grass or clover seed, we may expect substantial improvement.

Shall we Plough Pastures for Their Improvement?

That depends on circumstances. The improper use of the plough shows its effects everywhere on our worn hillsides, Whole townships have been impoverished by grain-raising, till by sheer necessity they were driven to pasturage. There have been some notable examples in Fairfield County, Connecticut. They raised rye and buckwheat till, some forty years ago, they could no longer harvest paying crops. Pasturage with fattening steers and the use of plaster was tried, with less ploughing, and the same hillsides have become covered with most luxuriant grass, pronounced by a noted cattle-breeder from another part of the State as "the finest pasture he had ever seen."

There may be a small income above expense in cropping these steep New England hillsides, and a temporary improvement in the pasturage from ploughing and reseeding; but too often the last state is worse than the first. The washing from disturbing the turf, which held in place the finer portions of the soil, and the destruction of many species of native grasses, which alone have power to withstand the increasing drouths and poverty of the soil, operate to make the fancied gain deceptive, and the loss to the land is greater than the apparent gain. Said a boy to me, "Why is he ploughing that hill?" "To raise a crop of buckwheat and then seed down to improve the pasture." "But, as he puts on no manure, I don't see how he is to gain anything." Neither could I. A very moderate dressing of stable manure, or of some fertilizer, would have made a great difference in the result. I have seen very remarkable benefit from the use of the plough and reseeding, with a very moderate application of manure, where the good grasses have died out but the land had not been exhausted.

If we examine a bit of good old pasture, we find the turf made up of a variety of grasses : tall fescue (*festuca-elatior*), red-top (*agrostis*), blue grass and spear grass (different species of *poa*), with a good sprinkling of white clover. This is a pasture that bears gnawing and bears drouth. In reseeding we ordinarily do all we can to destroy these species, and substitute generally only timothy and red clover. These make a rapid growth till the time of ripening seed, — can hardly be kept down, — and then with the drouth cease to produce. Close feeding then is fatal to them, or they reach the natural limit of their life. Clover is a biennial ; timothy requires a season of growth after seeding, to prepare the little bulbs for the succeeding year. The crowns of the clover are eaten out. The timothy is pulled up by the roots and nothing is left. A few add red-top or orchard grass ; but to make a complete and enduring turf, we should take counsel of nature and sow a variety of true pasture grasses. Here we are met by the difficulty of obtaining the seed ; its relatively high cost and the question of its freshness, caused by the small demand in the market. Make the demand regular, as for timothy seed, and the supply will be forthcoming at reasonable rates. So little is gained by the ordinary cultivation and reseeding of our steep hillsides, and so much is lost by the washing under culture and the destruction of the native grasses, I would bear long with such a field before resorting to the plough.

We spoke of the advantages to a dairy of little change of pasture. A neighbor had all his pastures in one range or connected together. His cows were allowed the entire range the whole season, and the produce of the dairy was remarkably good, even in comparison with that of those that were better fed. The cows were home grown ; ate in peace, "asking no questions," what was set before them ; and the regularity of their habits and freedom from excitement seemed to make amends for any scarcity. The lying-places were so fairly well chosen that this practice, for fifty years, was not as evil in results as we should anticipate.

I have noticed many examples of the suggested benefit from confining sheep and young cattle to portions of the range, and also united with the sowing of clover seed and use of plaster. In a term of years the pastures under this treatment showed marked improvement. Certainly, where we can harrow, sow grass and clover seed; and harrow in, with a dressing of compost, if it can be spared, whenever, from drouth or worms, the good turf fails. In many cases this is to be preferred to ploughing, as thereby what native grasses exist, which have showed their power to resist the untoward influences, are spared, and, with good seasons, will spread again to cover the ground. Only where foul stuff or bushes are to be destroyed would I prefer the plough.

Will it pay to use Commercial Fertilizers on Pastures?

That depends upon circumstances. If it will double the produce at a cost not exceeding the value of the land, I should say it would pay; for the better pasture holds out, even in bad seasons, and gives us pasture when we most need it, while a poor pasture gives its scanty feed when we have an abundance. Some applications, as ashes or bone-dust, change the nature of the herbage as well as the quantity. Clovers and the more nutritious grasses are encouraged, so that a portion of a field so dressed will be eaten down more closely than the rest, showing the preference the cattle have for it, and its presumed more nutritive qualities. We should hardly hope to eradicate weeds or bushes or to bring in good grasses in this way, where even the seeds did not exist in the soil.

Drainage and Irrigation

may do as much for our pastures, as for any of our fields. Land sodden with water never produces much, nor is the feed sweet and palatable. All wet or springy spots will be greatly benefited by open or covered drains. For thorough and sightly work the latter are always to be preferred.

Irrigation by turning a spring or small stream across a dry knoll will often accomplish wonders; or the water of a snow freshet turned on a hillside will make returns far exceeding the cost.

Warping, which Webster defines, from Gardner's farm dictionary, as "the process of enriching land by producing a deposition of the earthy matter suspended in rivers, which is accomplished by inundating fields for a short time," may often be practised with advantage, not only for enriching the soil but changing its nature, filling up swamp holes and covering rocky and uneven surfaces. Taking advantage of the spring freshets, some useless bank of earth may thus be transferred and deposited in the best shape upon some wet spot, where drainage would not be available. I have seen useless, miry muck, thus converted into fine, productive pasture.

Weeds and Bushes

infesting our pastures may be classed, first, as noxious; second, as arrant thieves, taking possession of the soil and crowding out useful vegetation; and third, as coming as occupants of an otherwise vacant surface. The lines between these classes are not clearly drawn, so that many of them would, in some cases, appear in more than one class. As noxious, we name, among shrubs, mountain laurel or calico bush (*Kalmia latifolia*), low laurel or sheep laurel (*K. angustifolia*), white bush (*Andromeda*); and among herbs, white hellebore (*Veratrum viride*), Indian tobacco (*Lobelia inflata*) and St. John's wort (*Hypericum perforatum*). All these are reported to be poisonous when eaten by animals, which is rarely done except from stress of hunger, or when animals are taken from places where these plants are unknown and are first exposed to them.

The poisonous nature of many of these plants is denied by some, but facts within my knowledge sustain their bad reputation. Destruction of the pest is the ordinary remedy; but in one case I have known an acre infested with sheep laurel to be fenced *in*, by a good farmer, to keep his sheep *out*. It is only in extraordinary circumstances that any of them are cropped by animals, hence the opinion that they are not poisonous.

The second class is more numerous; in fact, their name is legion. Buttercups (*Ranunculus acris* and *bulbosus*) extensively prevail in rich meadows and pastures. In the green state they are acrid and refused by all animals, yet dried in the hay they are eaten. As they are perennial, nothing but ploughing or digging out will eradicate them. Ox-eye daisy (*Leucanthemum vulgare*) is too well known to need any description. Cattle eat it readily when young, so that close pasturing early in the season will keep it in check, and sheep will eradicate it. Yarrow (*Achillea Millefolium*) is a bitter weed, rarely eaten in the green state by any animal, that favors warm, sweet land, capable of better things. Mullein (*Verbascum Thapsus*) is never eaten, even when dry, by any animal except the goat, which, I am assured, considers it a choice morsel. Wild carrot (*Daucus Carota*) is a new comer; an unsightly weed. As it is readily eaten by neat cattle when young, and by sheep even when in blossom, it does not spread in evenly-grazed, clean pastures, but must have the shelter of other plants to get a start. Common thistle (*Cirsium lanceolatum*) and Canada thistle (*C. arvense*) are both great pests, which spread exceptionally freely in sheep pastures. Horses sometimes crop the blossom-buds and prevent seeding, and they are crushed and broken down by cattle. Cutting will run out the former; for the latter I know of no certain remedy in our rough pastures. Sweet flag (*Acorus Calamus*) in borders of streams and swamps; elecampane (*Inula Helenium*) in rich, fat land; and tansy (*Tanacetum vulgare*) in warm, dry land, are all perennials, spread slowly but surely, are never eaten by animals, and, though planted for medicinal virtues, should be watched and extirpated before they get the upper hand.

In pasturing stubble fields, more often rye, we find the wild wormwood—ragweed (*Artemisia vulgaris*)—outgrowing everything else, and furnishing a questionable diet, especially for milch cows, as communicating its bitter taste to milk and cream. An annual, it has facilities for taking care of itself that are quite marvellous. Crowded in a thin soil, it will blossom and perfect seeds when but an inch or two in height; but give it the place of a hill of corn in a rich field, it is taller than one can reach and produces seeds enough to stock an acre.

There are two plants that nothing will eat, that will allow nothing else to grow to crowd them out, that never die, that spread both by root and seed, that cannot be killed by any ordinary means, and that have been widely disseminated as garden flowers,—live-forever (*Sedum Telephium*) and toad-flax, snapdragon, butter-and-eggs (*Linaria vulgaris*). Ploughing only multiplies and cultivates them, harrowing enables them to colonize, and digging up and chopping to pieces stem or root makes new plants ready to grow in any opportunity. When dug up they can be destroyed by burning; and the live-forever is the more easily got rid of, of the two, for fragments of the root do not sprout as readily as fragments of the stem. Covering the ground occupied by the snapdragon with salt, to the destruction of all vegetation, is the only means I know of that has proved effectual; while the live-forever may be extirpated by digging, picking and burning.

Various species of asters and golden-rod make neglected, rough pastures glow in autumn with their varied colors of purple and yellow. Close pasturing in the summer keeps these down and runs them out. Not that I call such plants good pasture; yet they must be eaten, or they will take up the whole surface in congenial soils. *Gnaphalium*, in its various species, from the mouse-ear of spring to the life-everlasting of autumn, as far as I have observed, is never eaten by animals, and is only tolerated because we know of no available means of getting rid of it. The mouse-ear indicates poverty of the soil and is driven away by enrichment, and doubtless the same would be effectual with the other species.

Brush or Bushes

represent a numerous host of intruders. The alder, willow, witch-hazel, thornbush, sumach and choke-cherry, only grow large enough for wood, yet destroy a pasture as effectually as good timber. Persistent cutting will destroy them, and as my success has not depended upon any particular season for the operation, I have none to recommend.

Smaller bushes, as sweet-fern, elder, bayberry, blackberry and raspberry, hardhack (*Spirea* and *Potentilla*), are great nuisances. Ploughing, where the nature of the land will admit, seems the best remedy. Cutting, followed by close pasturing, is sometimes successful with one or another of them; but the victories of the enemy have been so much more numerous than our successes, that on the whole we must own beat, up to the present date. The enemy have possession of the field.

A word about the hardhack (*Potentilla fruticosa*). This is a native shrub, too well known in Berkshire and Litchfield counties to need any description; yet, happily, almost unknown elsewhere. A bush scarcely noticed fifty years ago, it has now come to be the worst pest we have in our pastures. Thousands of acres of rich, moist, black land are rendered valueless by it. Mowing checks it; ploughing eradicates it; but it may come again. It delights in rough and wet places, — neither fit for the scythe nor the plough. It blossoms and perfects its seed when only a few inches high; but with age it becomes a large bush, six feet in height. It spreads alone from the seeds, which are numerous and perfected during the whole season. The blossoms are yellow, like a buttercup. The whole plant has a weak, sickly look, like the sage-brush of the plains; yet it never dies. It is easily pulled up, and every neighborhood where it is unknown should take warning and watch for the advance guard.

An old farmer said, "if he was to live his farm life over again, he would fight hardhacks with bran;" that is, by close feeding and fertilizing his pastures, he would keep it out. As a partial food it is eaten by cattle and sheep, but is refused as a sole diet. I have a field of four acres that was becoming covered with the hardhack. Fifteen years ago I changed it to a night pasture for my dairy. The close feeding and increased fertilization have nearly eradicated it, while a patch of sweet flag flourishes with unabated vigor.

To derive the full benefit from the close pasturing which I recommend, it should be accompanied with the feeding of bran, linseed or cotton-seed meal, or other grain. When horses were shipped from Connecticut to the West Indies, the droves would be kept at pasturage near the place of shipment for a few weeks, and fed bountifully with oats or other grain. Every green thing was gnawed down; but such fields and farms showed marvellous improvement.

I can specify few plants in the third class, — those that come in to occupy a deserted soil, — and indeed I am not sure of any; yet I have in mind many of the poorer grasses and sedges and weaker weeds that appear in all vacant places. I consider these as better than nothing, as holding the soil in place and preparing for a better vegetation; but I have not seen this result. Indeed, the chief individual I can name (*Danthonia spicata*), I have many doubts about. It is a thin, weak-growing grass, which abounds in neglected mountain pastures, its slender, dry columns whitening the whole surface; it may well be called poverty-grass. It has been charged as a thief, taking possession of the soil to the exclusion of its betters, for it is nearly or quite worthless. When fertilization and seeding with better grasses have been tried, and failed, then we will condemn the danthonia.

We have given truly a formidable list of what we would not have in a pasture; and, while we may take courage from the fact that while but few of these thrive in any one soil, — some taking the wet and others the dry, — some the rich and others the poor, — yet, in their combined numbers, they do rob us of much of the productiveness of our pastures.

The remedy that I have so often offered as effectual against them — close pasturing — will also, under some conditions, prove injurious to the better grasses. They need some seasons of rest from close cropping to occasionally form seed, and by developing larger foliage also a larger root growth. We need to keep some pastures ahead against a period of drouth. Keep that which will bear keeping, and by a judicious change develop the best productiveness of each field.

By this time you will see that I do not recommend any grand specific for our pastures, nor a "special fertilizer for grass;" but advise rather by a system of management providing as best may be for each acre or rod, to keep out thieves, to encourage the growth of the best grasses, to retain the natural fertility of our fields, and to increase it by the judicious feeding of such outside materials as seem best; or in some cases the application of bone-dust, plaster, barnyard manure or tobacco stalks. Even brush has been used to advantage in certain dry, clean pastures. Make the best use of materials at hand and we believe that our pastures may be maintained in a degree of productiveness equal to that of their virgin state when first cleared from the forest.

We have had these points in view continually during our long ramble through these dry fields, and if any of you see a chance to do something in this work our object is accomplished. It is not the work of a day, but rather of a lifetime, for which our subject calls. The means suggested seem trifling and feeble in comparison with the object, yet each in its place has been successful, and rightly applied they will meet every exigency.

The CHAIRMAN. There is still time before the adjournment for any questions that you may be disposed to ask, and Mr. Gold will be very glad and certainly able to answer any pertinent questions.

Mr. SEDGWICK. The speaker stated in his remarks that hardhack pulls easily. I would like to have him tell us what he calls *easy*.

Mr. GOLD. A man can pull a hardhack bush that is as big as a common currant bush, unless it is pinched in between two rocks or something of that kind. Ordinarily it can be pulled, and there are farms within my knowledge where a regular system of pulling has kept the land entirely clear when the whole of the surrounding territory had been given up to it. The white bush spreads from the root and becomes a tangled mass that the plough can hardly get through, and it cannot be pulled. You cannot pull a single specimen as big as a pipe stem.

Hardhack grows from a common neck at the ground. It maintains a large number of stalks, but the roots do not spread and spring up again, and hence the entire plant has a collar or neck from which it grows. The earth may wash in and these different branches may root in that way, but otherwise you will find a space at the bottom where there is but a single stem between the root and the plant part; and although it may spread and be from four to six feet across, and several feet high, it all has one common neck. Hence it can be readily pulled. But if earth has washed in, as it sometimes will near the banks of streams, and the limbs have fallen down and then rooted again, it may be more difficult to get hold of it.

Mr. GRINNELL. I think the difference between Mr. Gold and Mr. Sedgwick may be reconciled in this way. I have pulled acres of hardhack, but you must start early. If you begin before they are two years old, they pull easily; after they become old it takes a horse to pull them. But the treatment of hardhack, as I stated last night in regard to the daisy, is to pull it. You must, however, start betimes, before they get large. Either of these things the first or second year can be pulled without difficulty.

Mr. PIERCE. Is there more than one kind of hardhack? The hardhack which he shows is not what we call hardhack in Worcester County. That is a little plant which grows up some two feet high and has a pink pyramidal blossom, and does not branch out to any great extent.

Mr. GOLD. In the one place I speak of the hardhack as both the spirea and the potentilla, and in the other place I speak only of this potentilla, which is called "Goshen hardhack" and various other names by us; and it so far surpasses the other plant that we ignore that entirely. The spireas are comparatively harmless shrubs.

Mr. BROOKS. That is what we know in Princeton.

Mr. HEATH of Stockbridge. Do you know anything about a plant called "devil's rattle-box?" In Stockbridge the town is being overrun with it. Its one redeeming quality is that cattle will eat it in the green or dry state.

The CHAIRMAN. Can't you describe it so that he can identify it?

Mr. HEATH. It grows say fifteen inches in height and bears a pod that is full of seed, like mustard and tobacco seed,— very fine seed. It has a white blossom.

Mr. GOLD. I do not recognize the plant, sir.

Mr. WILLIAMS. I will add a little more to that description, being from Stockbridge, and having seen something of it. Some parts of the town are covered with it. I have been told that where a field is thoroughly filled with it, it will take a yoke of cattle to draw a plough through the roots.

The root at three or four years old will be as large as my finger, perhaps, at the top; it may branch a little. Where I have found it on my own ground, I have taken a spade and dug it up. I have dug a post hole down around this root to the depth of perhaps two feet, as low as I could get and work to advantage. Then I have pulled on that root and it has broken off, perhaps six inches below where I dug.

Mr. PALMER, of Stockbridge. I have seen a root of it ten or twelve feet deep in a gravel bed I was digging.

Mr. EDSON. We call that "lupin," on Cape Cod. There are two varieties, one has a white blossom and the other has a purple blossom.

Mr. HEATH. I once sent a root of it and some of the flowers and leaves to the "Country Gentleman" office and asked questions about it. Their reply was that they were as much in the dark as I was. It seemed to be a new thing to them. I know of no towns that have it except our town of Stockbridge and the town of Lee, where there is some of it.

Mr. GOLD. The lupin has a papilionaceous flower, like the pea. It has not a flower like the plant you are referring to.

Mr. WILLIAMS. If that plant is confined to Stockbridge, I would recommend to the people of other places to keep it out. I have tried to do so on my own place and feel that I have been successful. Whenever I see a single stalk I will go some distance to get something to dig it up, and when I go to the depth that I speak of, I am sure to break the root; I put a handful of salt in the hole, and every one that has passed the blossoming period I put in my pocket and carry to the house and put it in the stove. That is a practice that I have followed with many weeds, such as the wild carrot, the yellow daisy, etc. I have kept my farm comparatively clear, and every farmer who finds on his land these weeds, especially those that increase so rapidly, ought to take this course. I think it is the only way by which we can protect ourselves against these foul seeds that are coming in and are being increased so rapidly in number and variety. There are some farms within my knowledge, for which I would not give as much by one-half, on account of this foul matter that is in them, as I would if they were clear.

The CHAIRMAN. Mr. Williams has certainly kept his farm in a very commendable and desirable condition.

I beg to differ from the speaker in his statement with regard to the plant called "live-forever," that it cannot be exterminated. There are two ways that you can get rid of that plant. If you will plough the field very late in the fall and turn the roots up, every root that comes to the surface will freeze to death, and you have got rid of so much of it. There is another way. If you will seed it down and turn it into pasture, in three years you cannot find a particle of it. That I have tried and I know it to be so. This field that I have ploughed was solid with live-forever, you might say; it looked like a good crop of clover, and I have had people who came along say to me, "What a wonderful crop of clover you have there!" To-day you can hardly find a root of the pest.

Adjourned to two o'clock.

AFTERNOON SESSION.

The Board re-assembled at two o'clock, and the chairman introduced as the first lecturer of the afternoon, Mr. WILLIAM R. SESSIONS of Hampden.

SHORT-HORNED CATTLE IN MASSACHUSETTS.

BY WILLIAM R. SESSIONS OF HAMPDEN.

We learn from tradition, that hundreds of years before the Norman conquest, there was in the north-eastern counties of England, a breed of cattle described as "of large size, with short, stubby horns, coarse heads and shoulders, wide hips and thick, cloddy thighs." They were good feeders, slow to mature, but made heavy carcasses of beef, and were good milkers when well fed. They were also strong and docile for labor. These cattle resembled in some respects the cattle of north-western Europe. From this resemblance, rather than from direct evidence, it has been supposed that when the Danes invaded England they brought cattle with them, and that the union of their blood with the native cattle of England produced the breed thus described. These cattle were the progenitors of the short-horns.

This was a period of war and turmoil in Great Britain. Contests between invading Scandinavians and native Britons, followed by the Norman conquest, kept the people in barbarism, prevented improvement in agriculture as well as in manufactures and the arts. Cattle improvement was as slow as improvement in civilization. For centuries the common people were simply barbarians, and their rulers were robbers, from the petty baron to the usurping king. The people were ground down with taxes; were obliged to serve their masters in peace and in war. But as good men arose in the land, and by their efforts and influence caused improvement in the condition of the people, so agriculture improved, and from time to time attention was given to cattle-breeding. We have no definite records of their progress in this direction until about the year 1700, when we read of short-horns in great perfection, obtained by long-continued and well-directed effort. The cows were always described as deep milkers, and the bullocks as making great carcasses. There is a record at about this date of a short-horn ox, whose dressed weight of meat, hide and tallow was 2,479 pounds. The particular steps of improvement have not been recorded, and we can only judge by later experience of the patient study, close thought and perseverance, which this great progress cost.

About the year 1740 we begin to find definite records of short-horn breeding, and accounts of wonderful improvements made by careful experiments. Breeders began to keep records of lineage or pedigrees of their stock. In the year 1780 began the systematic and comprehensive efforts of the brothers Robert and Charles Colling, to improve the short-horns. They resorted to in-and-in breeding, and were wonderfully successful. Not only were the cattle improved, but the attention of the titled and wealthy was attracted to their herds. When the Colling brothers began their career there was no such thing known as fancy prices for cattle. The bull Hubback, afterward a very noted animal, was bought and sold by them at his value for beef. The popularity of their breeding became so great that after thirty years, at their final sale, the bull Comet 155 brought the then unheard-of price of 1,000 guineas. One cow at the same sale brought 410 guineas, and the average price received for 47 animals was 159 guineas. In an account of this sale in the London "Times" of October 19, 1810, it is said, — "Many of the cows were excellent milkers, giving twelve full quarts at a milking." Daisy, a small roan cow, but a grand milker, was sold to Major Bower. Her dam, old Daisy, gave thirty-two quarts of milk a day. Mr. Charles Colling reserved one cow from his sale, Magdalena, a great favorite, and an extraordinary milker, giving sixteen quarts twice a day. Mr. Whitaker, another well-known breeder, prevailed upon Mr. Colling to let him have her. Mr. Whitaker produced a fine milking tribe from this cow. As some of our most noted early importations were from his herd, perhaps an account of the milk production of his nine cows would not be out of place. I quote from a paper by Mr. William Warfield, in "Breeders' Gazette" of July 17, 1884: "There was probably no better herd of milk-giving short-horns in all England than that of Mr. Whitaker. He kept his large herd with a view to milk always. It was expected to and did supply the large number of miners on his estates with milk. As far as I know, all the animals from his herd kept up the reputation." In the famous pamphlet of Rev. Henry Berry, nine cows are named of those then at Mr. Whitaker's, as follows: — Yellow Rose at three years old gave four gallons two quarts twice a day; at four years old she gave four gallons three quarts twice a day. Red Daisy gave four gallons twice a day; Magdalena, upwards of four gallons twice a day; Wildair, four gallons twice a day; Western Lady, three gallons two quarts twice a day; Venus (sixteen years old), three gallons one quart twice a day; Alfreda, three gallons twice a day; Adela (first calf), three gallons twice a day; Yarm, three gallons twice a day. These nine head, taken at all ages, from heifers with their first calves up to old cows of sixteen years old, thus run from six gallons up to nine gallons and a half per day; or in pounds, at nine pounds to the gallon, from fifty-four up to the remarkable eighty-five and a half pounds per day. This was nearly sixty years ago.

The Booths have done much for the improvement of the short-horns. There have been several generations of them, all of whom have systematically pursued the even tenor of their way and brought much to pass. The *early* history of the noted herds bred by them often mentions the fact that the cows were deep milkers; but they were especially noted for great development of flesh. One of their noted cows, Birthday, having met with an accident, was slaughtered without stall-feeding, and her meat alone weighed 1,218 pounds, and the flesh over her back and loin was found to be five and a half inches thick.

This brings us to the time and doings of Thomas Bates of Kirkleavington, whose name is famous at the present day as an improver of this breed of cattle. He began his work as a breeder when quite young. He made his first purchase of the Collings, and thus wisely began where his predecessors left off. He was possessed of ample pecuniary means and was able to pursue his best judgment without regard to cost. Mr. Bates said of his first purchase, the original cow Duchess, — "I secured this tribe of short-horns, as superior to all other tribes of cattle; not only as small consumers, but as great growers and quick grazers, with the first quality of beef." He also states that this cow calved June 7, 1807. She was kept on grass only, and in a pasture with nineteen other cows, and made, in butter and milk, over two guineas per week for some months. We wish we had a statement of pounds of milk and butter yielded by this cow, but can only estimate from the money returns, remembering that seventy-five years ago the value of dairy products was very low. One writer states that this cow gave 28 qts. per day, and made from it 2 lbs. 10 oz. of butter, which would be 18 lbs. 6 oz. per week. She bred until seventeen years of age, and was always a great milker, but failed to bring a single heifer calf after Mr. Bates bought her. Losing all hope of getting females from her, Mr. Bates bought her granddaughter from a heifer which she had before he owned her. He was obliged to pay 180 guineas for the heifer, but he thought he could afford it, and the sequel proved that he was correct. He called her Duchess 1st. She was got by Comet 155, the best bull of that day. To this bull many of our New England short-horns trace.

After breeding in a close line with his Duchesses for some years, Mr. Bates brought the Princess bull Belvedere for an out-cross, and, a few years later, brought to his herd another infusion of Princess blood, by the purchase of the cow Matchem, thus uniting the blood of these two noted tribes of short-horns, Princess and Duchess. He, however, called all that he bred from them, Duchesses. From this management of Mr. Bates have sprung the cattle which have sold at such monstrous prices; witness the 8th Duchess of Geneva, which brought at public sale $40,000, and the 10th Duchess of Geneva, which, at the same sale, brought $35,000. But here it should be said, that Mr. Bates, unlike his successors, always set high value on the milking quality of his cows. History tells us that his dairy was also noted for the very superior quality of the butter made. The Matchem cow, brought into his herd as an out-cross, was described by him as an excellent milker. The bull Belvedere was also from first-class milking stock. The first Princess cow had a record of thirty quarts of milk per day.

Mr. Bates died in the year 1849, and his herd was disposed of at public sale, and many of the animals found their way to this country. Since Mr. Bates' time the dairy qualities of this noted tribe of short-horns have not been fostered. The enormous prices which they have commanded have precluded any but rich men from attempting to compete for them. Their breeders have turned their whole attention to symmetry of form and beef qualities. Still, here and there, we hear of a noted milker of this family. But breeders of these high-priced, fancy cattle have sought to dry the cow as soon as possible after calving, that she might the sooner become presentable for exhibition. It is not at all remarkable that such a course, followed from generation to generation, should breed out the dairy qualities.

But all the short-horns of England were not in such hands, and so escaped this treatment. The tenant farmers had learned their value for general-purpose cattle, and, encouraged by their landlords, had increased their herds of this breed until they had, at this date (1850), become the cattle of England; so much so, that in this country, in Germany, in France and in Ireland, they were known as the English breed. The landlords, desirous of realizing large rents, saw in these cattle the means by which their tenants could make the rent and pay the heavy poor-rates and taxes. They, in many instances, bought, at high prices, the best bulls, and allowed their tenants to use them without fee.

The dairy cow of England has, for many years, been of the short-horn breed, and to-day it is the same story. The dairy breeds, so called in America, are *not* crowding the short-horns out of English dairies. In fact the short-horns take the honors as dairy cattle at the fairs of Great Britain. The champion prize cow at the London Dairy Show, in 1881, was a pure-bred short-horn. And the champion prize cow at the recent Islington Dairy Show, was a grade short-horn. Our British cousins have created this breed for profit; it has been brought to its present state of perfection for a purpose, and it serves that purpose well. England, a country of little more than 50,000 square miles (but a trifle larger than the State of New York), has a population of nearly 25,000,000, more than one-third of which dwell in cities of more than 100,000 population each. And a very large proportion of the whole population is engaged in manufactures and commerce, and are consequently dependent upon the farms of England for their supply of perishable food. Their whole supply of milk must be procured from cows fed within their own circumscribed territory.

With their commercial eye wide open, with wit bought by experience, with all the known breeds of cattle within their own borders, the English farmers have anchored to the short-horns. The cows produce large quantities of milk of good quality, and when, by reason of increasing age or accidental injury, they are no longer profitable as milkers, they fat quickly and make large carcasses of first-class beef. The bullocks come early to maturity and furnish such beef as will suit an English lord, which seems a sufficient recommendation. As Massachusetts is nearly like England in the situation and occupation of her population, the facts in England will apply quite well to our own case. Here let me say that the short-horns of England are not all herd-book cattle, but, nevertheless, are short-horns; for short-horns had been bred for scores of years, I might almost say for centuries, before the first herd book was begun, and only a tithe of the pure-blood cattle in the country at that time were recorded in the first volume when it was published. Those owned by tenant farmers, who used them for dairy cattle, though often the get of the most noted bulls, were rarely recorded. You may find in England hundreds of herds of the best short-horn cattle in the world, none of which have ever been recorded in herd books.

But let us turn to our own country and our own experience. Some of the first importations of short-horns to this country came to the Old Bay State. They were from herds of notable milking records, and to-day we find among their descendants many choice dairy animals. But at the time of these early importations our farmers were very conservative; and having imbibed the mistaken opinion that these cattle were of delicate constitutions and difficult to keep, came to the conclusion that they were only suitable for wealthy fancy farmers, and consequently they failed to reap the benefits which were thus placed within their reach.

Not so with the farmers of Ohio and Kentucky. They saw their opportunity, and, with their neighbors of the other States west of the Alleghanies, absorbed most of these early importations. In these localities the short-horns have increased and made their owners wealthy. But there having been no market for dairy products in that section, the milking qualities were neglected. Each cow only raised her own calf, and too much milk was a nuisance. The milking habit not being fostered was in a great measure lost. Still there are often found, even in these sections, short-horn cows that make remarkable milk and butter records, showing that it only needs careful attention to this branch of the business to bring back even the Western short-horns to that condition of excellence in dairy qualities which always belonged to their ancestors.

As showing that dairy qualities have not been entirely bred out of the Western short-horns, the following statement of Mr. William Warfield of Lexington, Ky., may not be out of place. He says, in a late paper on milking short-horns: "I have always tried to keep this quality in view, as one of those without which no animal could be really up to the high ancestral mark. We have had at Grasmere, since 1824, more than two hundred cows that gave over five gallons a day. Thirty-five of these gave eight gallons or more; sixty-three gave between six and eight; one hundred and two between five and six gallons. This, it cannot be denied, is a good record, yet it must be remembered that the system pursued at Grasmere renders it impossible to test the milking of a cow till after she has passed beyond the prime period of her milk. The calf is here the first consideration. When the calf has had all it wants we take what is left. This goes on till the calf is at least six months old. After that we take the milk, and it is on the basis of cows from seven to nine months in milk that I draw my estimates."

Mr. Miller, a Virginia farmer, as early as 1783, long before the days of herd books, imported cattle that it has been demonstrated beyond a doubt were short-horns, and so marked were their milking performances that they were known as the milk breed. Their descendants were sold to Pennsylvania, Kentucky, and other neighboring States, under the name of the milk breed. It is recorded that it was not uncommon for cows of this family to give thirty-two quarts of milk daily.

There were numerous importations into Massachusetts from the year 1817 onward, for several years. In the year 1822 the cow Arabella was brought over. This cow produced the numerous family called by her name. They were excellent dairy cattle. In 1823 the cow Annabella, with some bulls, was landed in New Bedford. Her name will be found near the bottom of very many pedigrees of New England short-horns. We need not blush to see it there, for her pedigree is made up of a combination of the best of the old bloods.

Mr. Ambrose Stevens, in the "Kentucky Live-Stock Record," Vol. V., speaks of Annabella and her daughter Emma as being fine milkers, and that in those early days all their descendants in New England had that reputation. Confirmatory of this is a note to the first pedigree on page 96, Vol. IX., which states that Cora, a descendant five removes from this imported cow, gave at 5 years old an average of $23\frac{22}{30}$ quarts of milk per day for a month. One day she gave $26\frac{1}{3}$ quarts. She made $18\frac{1}{2}$ lbs. of butter in 7 days and $26\frac{1}{2}$ lbs. in 10 days. Another Boston importation was of the cow Agatha and bull Boston in 1830. Mr. Stevens says of Agatha and Boston, — "They both were fine, strong, healthy animals; both of roan color, of good quality, and the cow a great milker. And again, all the near descendants of Boston were excellent milkers, and some of them, notably Lucille, extraordinary both in quality of milk and butter, and of the strain generally. They were both a good feeding and milking family, and if the milk quality had been looked after they would to-day be great in the production of *it* and butter." Confirmatory of these statements about the dairy qualities of these cattle, is a note to the pedigree of Lucille, granddaughter of imported Agatha, Vol. 1, page 198, A. S. H. H. B., in which it is stated that in June, 1842, she averaged for the whole month 55 lbs. of milk per day. Her greatest yield in any one day was $59\frac{1}{2}$ lbs. She made during this month $14\frac{1}{2}$ lbs. butter in one week. In June, 1844, she gave during the first week, on grass pasture alone, 337 lbs. of milk, which made 15 lbs. 3 oz. of butter. On page 737, Vol. 9, a great-great-granddaughter in the female line, Laura 5th, is recorded, with a note to her pedigree, that she "has milked thirty quarts steadily when fresh in milk, and given an unusually large yield until dried off."

Col. Powell of Pennsylvania also imported some of the best dairy short-horns; and as some animals of his breeding came to the Eastern States, some of his dairy records may not be out of place. Mr. Warfield says, — "His imported cow, Belina, on a special test before witnesses, gave between Thursday morning, 24th of May, 1827, and Saturday evening, the 26th, three days, milk which made 8 lbs. 13 oz. of butter by the usual process. That is at the rate of $20\frac{1}{2}$ lbs. per week." And Belina was not a single example. "She transmitted her qualities to her descendants, and they are to-day almost invariably first-class milkers." If you turn to Vol. 2, A. H. B., you will find, in foot notes of her granddaughter and great-granddaughter, Belina 3d and 4th, that the former gave thirty-two quarts daily, and the latter was equally good.

Notwithstanding the fact that breeders of short-horns in this country have generally ignored the dairy qualities and allowed them to fade out of many herds, the several volumes of the Herd Book give a notable list of fine dairy cows, giving their product, but generally only of milk. In the first fifteen volumes (the twenty-seventh is now in press) the yield of twenty-eight cows is recorded by breeders who value the milking qualities of short-horns. The tests are for different periods, from a few days up to a full season, and if we get the average of milk per cow for the time tested, by reducing quarts to pounds, it gives the remarkable average of 60 lbs. per day for each cow. Thirteen of these twenty-eight statements add that the feed of the cows was grass only.

Having told good stories of the accomplishments of short-horns owned by others, perhaps I ought to tell the modest doings of my own herd. Fairy Belle 10th, a cow of my own breeding, at nine years old, during the year, from June 21, 1880, to June 21, 1881, gave 10,890 lbs. milk. By numerous tests we ascertained that 24 lbs. of her milk would make one lb. of butter, which would make her product for the year 453 lbs. 12 oz. of butter. The next year, from July 25, 1881, she gave 10,723 lbs. milk, which would figure 446 lbs. 12 oz. butter. The third year, from June 18, 1882, she gave 10,955 lbs. milk, which figures 456 lbs. 7 oz. butter, or an average, for three consecutive years, of 10,856 lbs. milk and of 452 lbs. 5 oz. butter. She was one of a herd of 16 to 20 cows, and had only the same care and attention that the other cows of the herd received. In the year 1880, 15 cows, of all ages, averaged 6,288$\frac{2}{5}$ lbs. milk and 261 lbs. 14 oz. butter. In the year 1881, 16 cows, all ages, averaged 6,350 lbs. 11 oz. milk and 265 lbs. butter each. Taking the 8 cows which were in their prime alone, the average was 7,252 lbs. milk and 302 lbs. butter per cow. In 1882, which was a year of short pastures on account of drouth, 19 cows averaged 6,221 lbs. 15 oz. milk and 254 lbs. butter per cow. Taking only the 10 mature cows and the average was 6,779 lbs. 15 oz. milk and 282 lbs. 8 oz. butter.

These yields are not claimed to be remarkable, but they illustrate what short-horns may do as dairy cattle when taken as a whole; for these cows were all raised on the farm and were the descendants of one thoroughbred cow, which was bought without reference to her dairy qualities. She had always suckled her calves, and no one knew what she would do at the pail. These cows were not selected animals, but having raised all our heifer calves, we had sold from the herd from time to time, allowing the purchaser to take his choice out of the herd. I have also a statement from Geo. E. Taylor, Esq., of Shelburne, Mass., that a pure-bred short-horn cow, Twinkle, owned by his brother, of the same town, gave 52 lbs. of milk per day, and that every pound of milk would make an ounce of butter; thus making 22¾ lbs. butter per week. Also Rose 8th, owned by him, which made 17¼ lbs. butter per week. I have also a statement from H. S. Porter, Esq., of Hatfield, Mass., that his cow Red Rose, at eight years of age, gave, in seven days, 371 lbs. milk, from which was made 15½ lbs. butter. I have also a statement from P. Stedman, Esq., of Chicopee, Mass., of a test of his cow, Rose 2d, for seven days, in which she made 17¼ lbs. butter.

I might multiply instances of like tests of pure short-horn cows, but these seem sufficient to prove that this breed ought not to be left out of the lists of dairy breeds. But the short-horns for Massachusetts are not necessarily herd-book animals which command high prices because of pedigree, but animals of five or six crosses, — cattle that under English rules would be eligible for record, but in this country are rated as high grades. Such animals can be bred by any farmer. We have almost numberless instances of short-horns such as these making remarkable performances in the dairy.

I make this statement because it has often been assumed, by the advocates of other breeds, that the short-horns are only a beef breed. It has also been claimed before this Board that first-class butter cannot be made from the milk of short-horn cows. In answer to that claim I may be allowed to instance the celebrated Darlington butter, made by the Darlington brothers near Philadelphia, which has a reputation second to none in the markets of Philadelphia and New York, and is even sent to Boston, where, I am informed, its reputation is not second to the fancy brands of Jersey and Guernsey butter which sell at 60 to 80 cts. per lb. The cows in the stables of the Darlingtons are grade short-horns. These gentlemen keep this variety of cows because, when they must be replaced in the dairy, they will sell, for the shambles, for almost or quite sufficient cash to buy another cow, and with proper feeding the return in butter is equal to what they could expect from any other breed. I may also, before this audience of Housatonic farmers, call to mind the fact that in your butter contests at your fall exhibitions, premiums have been won by exhibitors of short-horn butter in competition with that made from the milk of pure Jerseys. I will also state a well-known fact, that butter sent to Boston market from Franklin County, made from the milk of short-horn cows, has, for whole seasons, sold for a higher price than some made from the milk of pure Jersey herds. At the risk of seeming to boast, I will also state that several years since the president of the Hampden County Agricultural Society, the Hon. Norman T. Leonard, arranged for a contest at the county fair between the different breeds of cows, on quality of butter. He procured the exhibition of butter made from pure Jerseys, Devons, Ayrshires, Natives and Short-horns. For judges there were appointed three ladies of Springfield, notable housekeepers, who were unknown to all the exhibitors. These judges in their report used the following language:—"We think there can be no doubt but that the butter exhibited by Mrs. Sessions is the best." I need not add that Mrs. Sessions' butter was made from the milk of thoroughbred short-horn cows.

But in Massachusetts butter is hardly the principal dairy product. The last census gives the milk sold or carried to factories, at 29,662,953 gals.; the butter made by farmers is given as 9,655,587 lbs. This enormous quantity of milk is consumed principally by people who desire good milk, for which they are willing to pay a fair market price, and they prefer short-horn milk. The milk producers of this State like a cow that will give a steady flow of milk of good quality. They desire the cow to be a good feeder, of good size, with wide back and good hips, — a form that will give a good weight of the best cuts of beef. They have learned that the most economical method of producing milk is to feed generously, — keep their cows fleshy, — so that when circumstances shall indicate that, for any reason, the cow has passed her usefulness in the milk dairy, she may, like the Darlingtons' cows, sell to the butcher for a sum very nearly large enough to purchase a successor.

Such a cow is the short-horn; and as the short-horn is the dairy cow of England, so is she, without doubt, the cow for the milk dairy of Massachusetts. There is, and always will be, a brisk demand for cows at fair prices by the milk farmers of this State, and they want the cow I have described — the short-horn. This gives the farmers who live remote from railroad stations or manufacturing centres an opportunity to supplement their butter-making by the raising of heifer calves upon their skimmed milk to supply this demand. The short-horn cow will not only give good returns of good butter, but she furnishes a generous flow of milk which, when denuded of the cream is a good quality of skimmed milk; just the material, with the addition of a suitable amount of grain food, with which to grow heifer calves to supply the place of the old cows, and to sell to milkmen who have no skimmed milk with which to raise successors to *their* cows.

There is always a demand at generous prices for short-horn steers for feeding. If the steers are well matched they will bring a still higher price. A cattle trader in a town adjacent to the one in which I live, informs me that he has a standing offer of six cents per pound live weight, for all the well-matched, first-class, short-horn steers he can furnish. But he is seldom obliged to sell such steers for six cents per pound. It is surprising to what weights short-horn steers will attain, even in Massachusetts, if well cared for.

I find in Massachusetts Agricultural Report of the year 1852, from which I have before quoted, some weights of short-horns which were exhibited at the different fairs in the autumn of that year. They may be interesting in this connection. On page 127 of said Report, I find account of a fat ox, four years old, grade Durham, weight 2,200 lbs. Another, weight 2,160 lbs.; also a fat cow, weight 1,575 lbs. On page 239, a pair of twin three-year-old steers are reported as weighing 3,620 lbs.; another pair, weight 3,565 lbs.; another, 3,140 lbs., and still another at 2,940 lbs. Also a pair of two-year-old steers at 2,750 lbs., and yearling steers weighing, respectively, 1,905 lbs., 1,885 lbs. and 1,846 lbs. Also, on next page, mention is made of a pair of fat oxen, four years old, weighing 4,370 lbs.; of a fat cow, weighing 1,760 lbs.; also a fat three-year-old steer, weight 1,890 lbs. On page 298 of same Report we find account of four yoke of fat oxen from the town of Shelburne, whose average weight was 2,002 lbs. per head; and of one yoke from same town, six years old, which weighed 5,555 lbs., with the following statement of the manner and cost of raising them: "When calves, they were fed the first three months with skimmed milk, with a little meal ground from a mixture of three parts oats, two of rye and one of corn. At three months old they were turned to pasture till winter. From that time to June last (five and a half years), they consumed in all about fifteen bushels of meal, which was fed mostly to them during spring work. They were broken when two years old, and worked regularly on the farm until one year ago. From June last to this date, Sept. 29, they have been fed with meal twice a day, and have consumed in all 85 bushels of provender, mostly corn and oats. Total value $56.60. They have never been over-fed always leaving a clean manger. They were six years old last March, are seven-eighths Durham, were both sired by the celebrated Deerfield bull known as the Childs bull." The committee say, "Although now very fat, for aught that appears they may continue to increase in size and fatness for a long time to come."

The early reports of the Massachusetts Board of Agriculture have many records of short-horn cattle which are equally noteworthy; and the only reason that we fail to find them of late years is because "statements" are almost wholly excluded on account of lack of space at command of the secretary. But if any one desires to see just such cattle as these, let him attend the Housatonic, the Highland, the Union, the Deerfield Valley or the Franklin cattle-shows next autumn and he will find them, at all these places, numerous and excellent. As an example of steers raised from milking short-horns on both sides, let me instance the experience of a former member of this Board, Mr. Henry K. Herrick of Blandford. He purchased from a milking herd of short-horns the bull Joker. In answer to my inquiry as to his achievements as a stock-getter he gave me the following statement. It is not inserted as particularly noteworthy, but as a sample of the experience of many enterprising farmers among the hills of Massachusetts. He says of the bull Joker: "I think he left more good stock in town than any other bull in my remembrance. I sold a pair of steers of his get, last fall, which are now five years old. Their weight is now 4,500 pounds. They won the first premium at the Union Cattle Show last year as four-year-olds. Also first premium in four-year-old drawing class. Their weight as four-year-olds was 3,600 pounds. I had done my farm work with them that season, and in addition worked three or four miles of highway. They had also done my farm work the previous year, when three years old. I have at this time a pair of three-year-olds from Joker which weigh 3,545 pounds. They have done my farm work the past season, and have made a good gain in weight, as their last year's weight as two-year-olds was 2,770 pounds. I have also on hand a pair of two-year-old steers which weigh 2,400 pounds. They are nicely broken, but are thin in flesh on account of short pasture by reason of severe drouth. There are a number of pairs of steers in town of Joker's get, all good, powerful steers. I have some fine young cows got by the same bull which are as good dairy cows as I ever owned. We get as much for our butter per pound as any Jersey dairies in town that sell (as we do) at wholesale. I teach my calves to drink, and raise them on skimmed milk. My best steers were raised on skimmed milk."

Farmers are a conservative class of people. They have learned not to expect a bonanza in their business. They, as a class, are suspicious of cattle which sell at fancy prices. They have learned by observation, if not by experience, that the men who realize profit from such cattle, are not the men who farm to live, but are usually wealthy fancy farmers or speculators.

The short-horns have passed the speculative stage among us. Creditable pedigree animals can be procured for reasonable prices, and with good care and attention to the simple rule "that like produces like," every farmer may have his pastures and stables adorned with herds of grand cattle, — cattle which will not only pay good profits in the butter dairy, but will excel in cheese-making, and just what is wanted by the milk farmer; the steers will be in demand, at good round prices, for fancy matched workers, and for the feeders of beef for exportation. Every sagacious producer aims to furnish supplies which will be in general demand. An old-fashioned saying is, that "it is well to have more than one string for your bow." I recommend to Massachusetts farmers to stock their farms with cattle whose usefulness and profit have been proved by two centuries of trial by the tenant farmers of England, cattle which will adapt themselves to any climate, soil or circumstances, except the circumstance of starvation. They have won, in the western part of our country, the same position which they hold in England, and there is no good reason why they should not become the cattle of Massachusetts and New England as they are of old England. I believe that if, at the time of the first short-horn importations into this State, our farmers had been as thoroughly convinced of the economy of liberal feeding as they are to-day, the short-horns would have gained a general recognition in *all* parts of the State, and would now have been the universal breed of the State. But they were not calculated to thrive under the short feed, neglect and hardships to which our old-fashioned farmers were accustomed to subject their neat stock fifty years ago. At this day you can hardly find an advocate of short feeding; our progressive agriculturists *all* advocate liberal feeding for all growing, producing or working animals, no matter what the breed may be. With such sensible treatment the short-horns are ready to pay *certain* and liberal dividends to stock-raisers and dairy farmers, even in old Massachusetts.

The CHAIRMAN. I do not like to tax your credulity, gentlemen, but I announce that you will now be addressed by an agricultural editor who knows something about farming. I have the pleasure of introducing Mr. A. W. CHEEVER, of "The New England Farmer."

STOCK-HUSBANDRY IN MASSACHUSETTS.

BY A. W. CHEEVER OF DEDHAM.

Mr. President and Members of the Board of Agriculture:

LADIES AND GENTLEMEN,— In accepting again an invitation from your Secretary to contribute a few thoughts for the consideration of the farmers of Massachusetts, I have been asked to speak upon the importance of stock-husbandry in Massachusetts, particularly of the dairy, and also of the merits of polled cattle as compared with the other well known and more popular breeds.

In a report of the Secretary of one of our western Boards of Agriculture, I find these words: "Immigration is our great necessity, and nothing of labor or money should be spared, the expenditure of which will bring to us rapid immigration of the highest order of intelligence and moral worth. We believe no other means to this end will be found so economical or so efficient, as the world-wide publication of authenticated facts, faithfully and truthfully collected."

Through the liberality of the legislature, that secretary was enabled to send thousands of copies of his report through these old eastern States for free distribution. A few years later the secretary of that same Board of Agriculture was enabled to report that the population of his State had increased during the preceding ten years threefold, the value of the live stock had increased in the same ratio, while the number of acres under cultivation had increased nearly fivefold, and he believed that this great gain in the wealth and prosperity of the State was largely due to the influence of their Board of Agriculture and its published reports, which had been so freely spread over the country.

Now, if men and women of the highest degree of intelligence and moral worth are of the greatest necessity to a *new* State, in order to promote its prosperous growth, what, may we not ask, does an old State like ours need, to enable it to hold its own, and especially against a competition carried on for the express purpose of drawing away the best of our people? In the face of such a competition as the promoters of western immigration are now carrying on, with their voluminous agricultural reports, sent free to every applicant; their beautifully gotten up advertising circulars and pamphlets kept on deposit by the barrel in every important eastern railroad station and hotel office; their exhibition cars filled with the best specimens of grains, vegetables and fruits, grown on virgin soil, and wheeled around from one eastern State fair to another, every autumn, does it not begin to look as if the one great question which every one of us should ask is, What can Massachusetts farmers do to be saved? In answering this question I should say first,— see to it that the legislature sustains the State Board of Agriculture and puts it within the power of the Secretary to furnish every farmer in the State, who will take the trouble to ask for it, a copy of the annual report, and to the secretaries and members of Boards of Agriculture in other States, copies in exchange, as freely as they send them to us. Let the State Board of Agriculture of Massachusetts have the means of advertising to the world, and especially to her own citizens, what are the agricultural capabilities of her own soil, her own climate and her own home markets.

I had hoped to have been able to spend a larger part of the past summer among the farmers of our Western States, that I might have seen with my own eyes how western people live, and what advantages they may really have over us, that I might have had something to tell the eastern farmers this winter that would have been interesting if nothing more. I wanted to see a crop of corn and a crop of wheat grown on a prairie soil from the seed to the full corn in the ear. But the West is large, and I had only time to visit that part which *was* West a few years ago. I am not sure, however, that a Massachusetts farmer cannot learn the lessons which he needs to learn, quite as well in New York, Ohio or Kentucky as in any State further west. He will find in all these States men who left the East to find land that would produce crops with less labor, or with less manure than was required on the eastern farms which they had first impoverished and then abandoned. These States which I have named are, undoubtedly, among the best, agriculturally, of any in the Union, but the farmers there, as here, have to pick for the good land, and the desirable locations, and when they find both land and location that suits them, they have to pay high prices there as everywhere else. The lands which will continue to yield fair crops year after year, with the application of little or no manure, are the lands in river valleys that are overflowed every spring, and farming on these lands is not without its drawbacks. You all read in the newspapers of the freshets in Ohio last spring, but you cannot possibly fully realize what a mad current of water from ten feet to thirty feet above its usual level means, till you have seen it running across your own farms, carrying away your fences, drowning and floating off your cattle, sheep and swine, and, perhaps, softening the mortar and undermining your best brick houses, so that they must be taken down and rebuilt. On one of the best farms in the Muskingum Valley I saw about eight acres of good land entirely spoiled by the last spring flood, the soil in some places being scooped out to the depth of from five to twenty feet, in others, deposited in such quantities as to ruin the land it covered. A river valley farmer may not get wholly discouraged by such freshets; he may even enjoy setting monuments of stone to mark the high-water line that he may astonish his friends with statements they can scarcely believe; but it would take some time for the farmers on these Berkshire hills to get used to such uncertain methods of enriching their fields. Perhaps there was nothing that impressed me more during my rambles than the fact that the best farmers are not by any means surely to be found on the best lands; I mean those lands which nature seems to have done the most for. We have heard a great deal about the famous "blue-grass" regions of Kentucky. They are about four degrees south of the latitude of Massachusetts, and have a climate so mild that cattle can feed in the pastures all but about two months in the year, and sometimes all the year.

Barns, such as we use for our cattle in New England, are almost wholly unknown. The people, generally, appear to believe that they are the favored people of the earth; that Kentucky blue-grass, Kentucky blue-grass lands, Kentucky horses and Kentucky whiskey are each and all the very best of their kind in the world. They boast of all these, as well as of their hospitality and of their handsome girls. I found good land in Kentucky,—I think I never saw better anywhere; good pastures, good horses and handsome fat cattle feeding in them; and at the railroad stations I saw many bright-faced, handsome, happy-looking young women on their way to attend the musical festival in Cincinnati. The men who accompanied them were generally bright-looking, too; and from what I learned by conversing with them, they are not very hard workers, for they can obtain what they consider the necessities of life, and some of the luxuries, without very great effort. But these people of comparative leisure and independence do not represent the average Kentuckian; for I saw, loafing around the railroad stations, at the corner stores, and at work in the fields, an entirely different class.

I saw at Lexington a horse that was, doubtless, worth the $25,000 he cost; but I saw, also, harnessed to public vehicles, carts and ploughs, horses that no horse owner, either in Kentucky or in Massachusetts, would be likely to brag much about. As illustrating the comparative condition of the land, the crops, the animals and the people of Kentucky and of New England, I wish to repeat, as nearly as I may, what I heard a Kentuckian say of them. I was travelling from Bloomfield to Louisville, and in the car-seat directly behind me were two Kentucky farmers whose business was raising and trading in cattle. One of them had just started on his second trip to New England for the purpose of buying grade Jersey cows to improve the dairy herds of his own State. As strange luck would have it, he had my name in his pocket, among two or three other New Englanders whom he had been directed to call on for information relating to the object of his trip. Of course we were not long in getting acquainted, and it was natural that farming in Kentucky and in New England should become the principal topic of conversation. At first his companion did a large share of the talking, telling me of the excellence of the blue-grass lands, the horses, cattle, etc., and, as usual with his people, claiming for them all superiority over anything in their line in the world. He doubtless believed what he said, for he had heard the story told, over and over again, since his childhood, and he had never been far from his own State. The other gentleman, to his honor be it said, was bound to see fair play and to give credit where credit was due. He said that he was well aware that Kentucky had good land, splendid horses, hospitable men and handsome girls, but Kentucky did not hold the monopoly of these blessings. He had seen considerable of New England during his former trip, and he thought he had had a good opportunity to learn of her people, of her soil and its productions. He said that although Kentucky had bred some of the finest horses in the world, she had also bred many poor ones; and if two territories of equal size were selected in both Kentucky and in New England, and the average quality of all the horses in each section compared, it would be found that the New England horses would show to the best advantage. The average horse of Kentucky, the horse that does the farm work, carries the family to church, or, one at a time, in the saddle, to the post office or the store, is quite apt to have a little too much blue-grass in his belly to show off well in comparison with his grain-fed, stabled cousin of New England. He finds hills where the New England horse would think it all level road. As to cattle, if the Kentucky breeds were the superior, he would not be on his way to New England to buy grade cows, that the Kentucky dairymen might be enabled to improve their own herds.

Of the hospitality of the people of New England, after having been driven about over the country from farm to farm by men who had no expectation of making a dollar out of him, he could hardly say enough. Then, if "handsome is that handsome does," the average New England farmhouse, presided over from parlor to garret by New England wives and daughters, would present to any Kentucky visitor a model of housekeeping such as he had never dreamed of.

I should detain you too long were I to repeat one-half that he said in praise of the little home of a poor laboring man in New England; the perfect neatness in kitchen, bedroom and wood-shed; the little economies practised to make both ends meet, and yet, the generous hospitality displayed at the table at which he sat and dined.

But what has all this to do with stock-husbandry, or dairying in Massachusetts? Something, I hope. I would have the farmers of Massachusetts know that the competition from the West is not nearly so bad to butt against as many of us have imagined. Good, rich land, free from all obstructions, has a tendency to make a man grow lazy. He falls into the habit of depending for his income upon just what his land will annually produce under a system of culture requiring the least amount of labor. Good land that is somewhat obstructed by rocks and stumps, or that needs draining to render it perfect for cultivation, will bring out a man's enterprise if he has any in him. The very effort required sharpens one's wits, stimulates energy, and gives one almost a love for his work. From the reports of others I had believed that as good places for carrying on farming, either upon a small or upon an extended scale, could be found in Massachusetts as elsewhere; but that belief has been greatly strengthened by my summer's experience. The average farmer who cultivates the land in Massachusetts is quite as well paid, and is quite as well off every way, all things considered, as is the average farmer anywhere else. When I last spoke before this Board, I said that I had come to look upon the artificially prepared, concentrated fertilizers as the powerful lever by which the intelligent farmers are going to be able to completely upset and revolutionize the prevailing sentiment concerning New England agriculture. I do not wish to retract that statement now. Commercial fertilizers will give any farmer, having faith in them, and the intelligence necessary for their judicious purchase and use, the power to take a run-down farm, and almost immediately put it into a productive condition. Fertilizers will also enable the farmer having a farm that is not half utilized, to put the whole, or whatever portion he chooses, into as good condition for use as the small part that he has been cultivating. We need no longer wait the slow process of building up and improving a run-down farm from its internal resources alone.

Swamp muck, forest leaves and road-side scrapings are all useful so far as they go; but it is slow work improving a large farm by these alone, and while the improvement is going on, the interest and taxes may be drawing upon it at a greater rate; so that our stern chase, which is always a long chase, may be in pursuit of a craft that is lengthening the distance between us. So I have nothing to take back that I have said in favor of commercial fertilizers, or of the leverage they may give us; but I wish to say further, that I believe the great power which for many generations yet to come is to keep New England agriculture abreast with the demands of the age is a judicious system of stock-husbandry.

Massachusetts annually purchases large amounts of both hay and grain for feeding her horses and cattle, and yet, with all this extra feed, she keeps only about one animal, including sheep and young cattle, on each five acres of improved land. Now there must be very little improved land in Massachusetts which, if put in suitable condition for cultivation, cannot be made to produce forage enough, so that a single acre may keep an average sized animal a year. The experience of good farmers proves that two acres is a large allowance for keeping a full-sized mature cow or ox twelve months; and on this basis we could keep two and a half times as many animals as we now keep, and that, too, without buying either hay or grain for them from abroad.

I have but recently returned from a trip among the dairy sections of the Connecticut River Valley, where I visited several of the best-managed and most successful associated dairies. I found that where associated butter-making had been introduced, the farmers are getting better prices for their products than before, and that these better prices are stimulating them to farm their land better. Yet, it seemed to me that, as a rule, they are not farming half as well as they ought; that they are not keeping half the amount of stock they might, and consequently are not making half the profit that they would if they did more with the land they own. The almost universal complaint at every factory I visited was that the farmers do not make so much milk as could be used, nor as much as the makers would like to use.

It is a great gain to fifty patrons of a factory to have their butter all made by one maker, and that maker the most competent of them all. It saves running the other forty-nine churns; saves, indeed, a very large part of the labor; and saves it, too, where relief is most needed, in the kitchen of the too often over-worked farmer's wife. Yet, if a creamery is built and equipped, and a butter-maker hired, who, with the use of the building and fixtures, could easily make three hundred pounds of butter per day, and his patrons send him milk or cream enough for only one hundred pounds, he can certainly earn but one-third of his salary, and the capital stock invested must pay less than one-third what it might pay; for the interest, taxes, and most other expenses are the same, whether the factory is run to its full or partial capacity. The farmer, too, who carries his milk to the factory, as many of them do, twice a day in hot weather, travels the same number of miles whether he carries forty quarts or four hundred quarts. An enterprising and successful manufacturer never allows his employees or machinery to stand idle one-half the time, when the products of his business are in good demand in the market at paying prices.

The village grocer may make as large a profit from a penny sale of confectionery as a farmer makes on a quart of milk; but if the grocer's sales are confined to the trade of a score or two of school-children, he must have a very small income from which to pay store rent and other running expenses. Now, the great mistake that many Massachusetts farmers make, is in hoping to obtain a liberal income out of a very small business, while they are incurring expenses sufficient for carrying on a much larger business. The time is entirely gone by when the farmer of Massachusetts can afford to cut the living expenses of himself and family down to the income from the sale of the spontaneous products of his soil. The age demands that the farmer shall live better than that. The farmer of to-day must have a comfortable, good-looking carriage, perhaps more than one; his wife must have an attractive and well-furnished parlor or living-room; the girls must have a musical instrument, and take lessons in the use of it; and the boys, who desire it, must have as good an education at the technical school or college as the sons of the merchant or professional men have. To accomplish all this requires money, and to make money at farming a man must go about it in a business-like way, and endeavor to make as large a per cent. of profit on the capital invested as possible. To do less than this would be unbusiness-like. It would be like leaving half the potatoes in the field undug, or half the grass in the meadow uncut; for to produce less than we might with a given expense, is no less a waste than to leave crops already grown unharvested.

A word now as to the profits of farming, for I think there is a fallacy connected with very much of the farm figuring. To illustrate: A farmer friend, who does some legal writing for his neighbors, was recently called to write a will for an old neighbor of his, who somewhat surprised him by showing a larger amount of property than our friend had supposed him worth. He accordingly asked the old gentleman, after he had finished the writing, if he would tell him how he had managed to accumulate such a handsome property with no other visible business than farming. "Well," said the old man, "I don't know as I can tell you how I made my money, unless it was by raising steers and selling them at a loss; for the sale of oxen and steers has been the chief source of my income, and I have generally sold them for less than cost, figuring the value of the food consumed at the market rates in my town." Was there not a fallacy here?

There was a book published in this State, about twenty-five years ago, entitled "Farming as it is," in which the author attempts to show by figures that every calf raised, and every crop grown, costs more than it will sell for, and that our Boards of Agriculture and our agricultural societies are doing nothing better than to encourage just such farming as that,— raising cattle and crops and selling them at a loss. Now, if our income is greater every year than the sum of our actual expenses, and the balance surplus is in hand where it can be counted, however badly our accounts may look and however poor our figures may seem to make us, there must be a fallacy about them somewhere. How do we sometimes figure up the cost of our milk? First the hay is charged at full market rates, the grain is worth so much a bushel, the cow is worth a certain number of dollars, and the cost of doing all the work of feeding and milking the cow, cleaning the stables and hauling away the manure is another certain sum. Add together all these items for one day's expense, divide it on each quart of milk produced, and the rate per quart may be above the price it will sell for; yet, if the farmer raised all that hay and grain, and did all the work of caring for his cow, he may have a balance in his treasury that his figures fail to account for. If that man's arithmetic were to be accepted he might well be suspected of having stolen the loose money found in his pocket. But those figures are not correctly placed. We have no right to charge our cow with the price those consumed crops would have sold for in market, unless we also credit the farm with whatever of profit there may have been from the production of those crops and selling them at full market rates. The hay grown on our Massachusetts farms does not cost what it will usually sell for in market. The cost of a ton of hay to him who produces it is just what it will cost to grow that hay and put it in the barn,— perhaps five dollars, perhaps more, perhaps less. If the meadow on which it grew can be made to yield uniformly, year after year, by top-dressing it with the manure made from the hay, the cost will be reduced to the interest and taxes on the land, the labor of applying the manure, and the cost of cutting and housing the hay. If I do all my team work with oxen that are so well fed and cared for that they can be made to bring in a handsome income from their growth or increased value as beef, I cannot charge their labor into my farm expense account, and give neither the farm nor the oxen due credit, without doing violence to all the rules of book-keeping. If properly placed, figures will not lie, but otherwise they may deceive most mischievously.

We have been complaining somewhat of late of the low prices at which our milk is selling, and it would be very gratifying to us if it would bring more. It would bring us more if we only knew how to reduce the cost of selling it. But even at the low prices at which our milk sells at the farm, the fact still stares us in the face, that if we will not longer sell at those figures, there are plenty of others, not far away, who will be glad to do so. The price of milk, like the price of railroad transportation, is necessarily based, in a measure, on what "the traffic will bear." The milk producer is to be commended for all his honorable efforts towards securing a reduction in his expenses for selling, but he should remember that the tendency of the age in all departments of manufactures is towards a reduction in the cost of manufacturing. The result of the adoption of the associated system of milk supply in the city of Syracuse is, that the consumers get their milk cheaper than in almost any other city; and I found milk retailing in Springfield, the other day, from the wagons of the new milk association, at six cents per quart, and trusted out at that. But the milk association have the facilities for making butter, and can use their milk in whichever way may prove most profitable. The milk of the country can no longer be made exclusively from the feed in our pastures. An entirely different style of farming is now required. Milk can be cheapened in its cost of making, by forcing each acre of the farm to do all it is capable of doing, instead of letting one-half or three-fourths of it lie comparatively idle, and until we do this we ought not to complain because others are willing to under-sell us in market. By cultivating well all our land, we would find that we could produce all the feed required by our cows, so that the cash received for milk would not, as now, nearly all be required for the purchase of cattle foods, as is the case with far too many of our milk producers.

We should also raise more of our cows, and thus save another large item of expense. Massachusetts farmers sell far too many veal calves, as well as others too young to be entitled to the name. Killing calves by the thousand, at from three days to four weeks old, entails a public loss; and we should not forget that losses fall eventually upon individuals somewhere, and we may rest assured that the farmer will not escape his full share. There is no time in the life of an animal of the cow kind when it will pay as well for the food consumed, provided it is properly fed and cared for, as during its first two years. The experience of all cattle feeders everywhere accords with this statement. Every butter maker, therefore, whether his milk is skimmed at home or sent to the factory, should endeavor to raise all his promising heifer calves, and I believe many of his steer calves too. Until there is a decided change in the practice of the dairymen in general, the profits from winter dairying will be greater than from summer dairying. The majority of butter makers in the country have not yet learned that good butter can be made in cold weather, so they continue to make poor butter in summer. Fresh, sweet butter, for several years past, has brought from twenty-five to thirty-three per cent. more in winter than in summer, while the cost of the labor of making is considerably less in winter.

I would, therefore, advise having more of the cows come in milk in the fall, and I would feed the calves liberally, in warm stables, on milk and dry food until they are six or eight months old. I would have them fed and cared for so well that they would make good heifers for milk by the time they are from twenty-four to thirty months old.

Applying the same rules for finding the cost of raising a cow that we did for determining the cost of raising a pair of steers, and we ought to find that the expense of raising good cows is less on butter-dairy farms than it will cost to buy them and less than they are actually worth for service. He who depends upon purchasing all his stock will generally find that he will have to buy more than two cows to get one good one, while he who raises his calves from good stock and treats his young animals well ought to do much better than that. If the right kind of stock is kept, there need be no loss if an occasional heifer fails to make a first-class cow, for it can be fattened during its third or fourth year and make excellent beef, that will be worth, either for home consumption or for sale, more than it has actually cost. Farmers of Massachusetts patronize their own feeding stalls far too little and their butcher's wagon far too much, and pay a very large margin for the privilege. No better meat was ever eaten than can be made from a steer or heifer between ten and twenty months old, nor can it be ever made at less cost.

In heavily stocking a dairy farm, I would let the young cattle have the pastures chiefly, giving extra feed whenever needed for keeping up a continuous, thrifty growth. The mature milking stock I would feed mostly at the stables, giving green or dry fodders grown especially for the purpose.

I cannot believe that a piece of good tillage land once made rich cannot be kept so permanently by returning to it all the manure made from butter cows consuming the crops grown upon it. If more is needed, it will be a little bone, to offset the loss from the sale of the few animals that are fattened upon dairy farms. The sale of butter takes practically nothing from the soil to make it poorer, and, so long as Massachusetts goes outside of her own borders for five-sixths of all the butter required for her consumption and trade, there would seem to be no grounds for fears of over-doing the business of butter-making.

It is certainly to be lamented that our Massachusetts farmers do not more fully appreciate the advantage they have in their home markets. In Ohio I saw, last summer, a country storekeeper taking in butter from the farmers in the vicinity, and paying for it in goods at prices ranging from five to ten per cent. higher than the same class of goods were selling for in the vicinity of Boston, or in Massachusetts generally. And what do you think he was paying for that butter? Fourteen cents a pound for ordinary, and fifteen for the best! Is western competition of that sort going to seriously injure the Massachusetts dairyman's butter-market? And yet, that butter was made in a neighborhood where farms are held at a hundred dollars or more per acre.

The competition to be feared is the competition brought against us by the best farmers, wherever they may be found. There is nothing whatever in the way of farming just as well here in Massachusetts as anywhere at the West. As a matter of fact our farmers in Massachusetts and in New England generally, as badly as we work our land, are excelling the western farmer in nearly every department. According to the census returns the agricultural statistics of Massachusetts, Kentucky and Ohio stand thus: —

	Massachusetts.	Ohio.	Kentucky.
Bushels per acre, Corn, . . .	32	33	24
" " Barley, . . .	27	30	24
" " Oats, . . .	32	31	12
" " Rye, . . .	10	13	8
" " Wheat, . . .	16	18	11
" " Buckwheat, . .	13	12	10
Average value of farm land per acre,	$73 00	$62 60	$30 00
Average value of products, . .	12 00	8 66	6 30
Value of live stock per acre, . .	6 00	5 70	5 00

In no single crop does the great blue-grass State excel our own in yield per acre; and in only four crops out of the six does Ohio excel us, while in the other two we excel her. But it is when we compare the cash receipts per acre from the sale of the crops in these three States that we realize the advantage the Massachusetts farmer may have on account of his nearness to a good home market. Here we get $12 per acre for our products against $8.66 in Ohio and $6.30 in Kentucky.

The two principal crops that the dairy farmer here in Massachusetts should raise are Indian corn and grass, each to be liberally fed, both green and dry. Now, while the western farmer may have the advantage of using more labor-saving machinery in the cultivation and harvesting of his small grains in a country so largely devoted to grain raising, I cannot see where he has any such advantage in the cultivation of grass or the corn crop, for we can afford to use all the labor-saving machines required for producing these crops at the lowest cost. I can see no reason why each of these crops cannot be produced as cheaply here as there if we will do our work in the right way and at the right time. We must feed out the fodder we raise, must make all the manure we consistently can, and save and judiciously use all that we make. We must cart this manure and spread it upon the land at the seasons of the year when the work can be done most economically. We must use good implements and give thorough culture, and we must harvest both grain and fodder with the least amount of waste. There are other crops that it will pay to raise here for feeding dairy cows and other stock, such as rye, barley, oats and millet, but I would treat these as grass, feeding green or dry as occasion may require. Every year adds to my faith in the soiling or stall-feeding system of keeping dairy stock. Western farmers are adopting it to a considerable extent to help them through unfavorable seasons; and if the system is profitable there, with their cheap, rich lands, it certainly should be many times more so on our longer cultivated soils, and where the good land is worth more per acre. Stall-feeding saves manure, economizes food, and enables us to nearly double the productive capacity of our farm lands.

In treating the subject of stock-husbandry in Massachusetts, I have not intended to make it a hobby for the hour, and ignore all other branches of agriculture. There are farmers in the State who can make more money per acre from garden vegetables, orchards or small fruits as leading crops, than they could make from the feeding of cattle; but these are not in the majority, and even these, many of them, would do well to keep more or less dairy or other live stock. Some of our market gardeners find they can keep dairy herds of considerable size and with a good profit, largely upon the wastes from their gardens and orchards. Neither did I deem it necessary to dwell upon the mechanical work of making butter or cheese. Of the details of cheese-making I know very little, practically, and butter-making has been written upon and discussed, and the same old story told and retold so often, that it would seem that it must be tiresome to an audience composed largely of dairy farmers. We all know without having it retold us that good butter calls for good cows, good food, pure water, kind treatment, a proper temperature and a suitable place for setting the milk, early skimming, skilful churning, working, salting, coloring, printing or packing, and the most scrupulous cleanliness everywhere and at all times. "Scrupulous cleanliness," by the way, is a term that is not original with me. Then, after butter is made, one, to be successful, must know how to sell it, which is not always the easiest part. A good merchant or peddler is far more likely to be born one, than to acquire proficiency in that line at an agricultural convention. I shall be glad, at the proper time, to answer any questions upon the details of butter-making that I may be able to answer. I shall ask your further indulgence but for a few moments.

Polled Cattle.

In years past, papers have been read before this Board to show the merits of pure-bred cattle, and, through lecture or discussion, most of the well-known breeds have had their good points ably presented. But not much has been said in favor of the hornless or polled cattle of any breed. One reason for this probably is, that there have been comparatively few polled cattle to talk about. Although hornless cattle have been bred for centuries, it was not till within a comparatively recent period that these quiet, peaceful animals came to receive public attention. Whether the original cow carried horns or a smooth poll is a question that can hardly be answered with certainty at this distance from creation. A picture of the Garden of Eden, with the animals all yarded while waiting their turn for a name, would hardly be regarded as authority upon this question. Sure it is that horns are useful weapons of defence upon the heads of wild cattle roaming in forest or on open plains. Horns help sooner to decide the question which of two or more animals is the stronger, and therefore best fitted to survive and perpetuate his kind. Horns, too, from dead animals, are useful in the arts for various purposes, — combs, buttons, etc. But at this late day, with our useful animals brought under domestication, can any one tell of any necessity for retaining the horns if they could readily be disposed of? Who, if they could, would add horns to our horses or our swine? Who would not be glad to breed out the tusks from the jaws of our domesticated boar? And who but a breeder of fighting cocks would not prefer male fowls without spurs? It has been the aim of modern breeders of swine to breed out just as large a proportion of the less valuable parts as possible; and the result is a pig, now, with a nose hardly long enough to ring, a tail too small to hold on by even when not greased, and with almost no bristles at all. The short-horn cattle, which have had more done for their improvement as domestic cattle than perhaps any other breed, have very insignificant horns, compared to the horns of the half-wild cattle of Texas; but they have too much horn still. The Jerseys, another breed that has been greatly modified by man,—or woman, for in the Channel Islands women take the chief care of the cows,—have very small, weak horns, which are easily broken off in frolic or in battle; but still too many remain unbroken, particularly on the heads of the bulls.

While I was writing this paper the mail brought me a letter from a New Hampshire farmer-philosopher, concerning horns on cattle. It was short, had no waste words, and reads thus: "Chickens that feather young are hard to raise. Fowls stop laying when they moult. What does it cost to make horns? There is no hair upon them to keep them warm. There is no covering of fat over the blood vessels in the horns to protect them from the cold. What does it cost to warm the blood that is cooled in the horns? There is nothing in animal economy too small to be of interest." Can any one detect any flaws in that philosophy? A great many pigs have lost their tails because of the common impression among farmers that it takes a peck of corn to grow a hog's tail. I will not attempt to decide the question whether a peck is too large or too small an allowance; but certain it is that to grow all the pigs' tails in the country requires a great many bushels of corn. So, too, it requires food to grow horns; and the point made about the cost of keeping the horns warm in a climate like ours, where the winters are long and cold, is a point that is not badly taken. But my principal objection to horns on domesticated cattle, is because of the danger to each other and to their attendants.

It was something more than sixteen years ago that I became interested in hornless cattle. There were at that time, as now, three distinct and well-known breeds of cattle in England. Doubtless, polled cattle were occasionally imported with others to this country from England and the Continent, as there have been polled animals found in our herds all through the States for many years; but at the time I began to breed them I knew of no pure-bred herd of them anywhere in this country. Now, the polled breeds are all represented in this country by good herds and by organized associations of breeders. The three distinct breeds are the Galloways of southern Scotland, the Angus or Aberdeens of the north, and the Red Polls of Norfolk and Suffolk counties in the south of England. The stock that I bred was from a cross of the Suffolk with the Jerseys. My experience in breeding from that stock taught me that horns are not only useless on our cattle, but that they are worse than useless. They are a nuisance that ought to be abated.

It may be thought that oxen should have horns to hold their heads in the yoke; but if a yoke is properly fitted, so that an ox can do his best both at pulling and backing, it will rarely touch the horns. It is the bad-fitting yoke, with bows too wide or too large, that requires the horns to hold back by. It is true that a polled cow in a herd with horned cattle will sometimes learn to rule the yard. I once had such an animal before I began breeding them. A polled cow that knows how, and finds she must fight to save herself, can whip any horned cow of her size, for the horned cow cannot hold the head of the polled animal, and the latter easily slips by and hits the shoulder of her adversary in a tender place. I have bred perhaps a hundred polled cattle, have had thirty on hand at a time, have had only polled bulls during the past sixteen years and have kept them till well into years, but among them all there has never been a vicious animal. I could turn my whole herd of thirty, of all ages from the mature bull or cow to the yearling heifer or unweaned calf, into a small yard together and feel that they were all safe. As many would drink together from the same trough or tub as could crowd their noses down to the water, young and old drinking together promiscuously. I have never had a "master" cow since I bred polls, and every dairy farmer knows what that term means when applied to a cow. It means that no other cow can leave the yard, go into the stable, or drink at the tub, till it suits the pleasure of the master cow. It means that if another master cow happens to be purchased from another farm and the two are turned loose together, that it is likely to be death to one, or battles all summer. After getting an entire herd of polls I was not kept awake nights with fears that some cow might get loose from her stall and injure her companions.

Perhaps in justice to myself, as well as to those who invited me to treat this subject, I ought to say that I am not at the present time a breeder of any kind of cattle, and can, therefore, discuss the subject of polled cattle without being open to the charge of having an axe to grind, nor any horn of my own to blow. While I owned polled cattle and had them for sale I could never feel at liberty to say publicly half so much in their favor as I believed their merits would justify. Horns upon cows' heads, like pistols in boys' pockets, make them dangerous companions to associate with; for what is a horn or a pistol good for if never brought into use? A herd of polled cattle kept by themselves will run together as peacefully and safely as a pen of pigs or sheep. They are never afraid of one another, because they never injure one another, and not getting injured they have no cause to get angry or become vicious. I have been visited by men who were prejudiced against polled cattle, because, as they said, they looked so odd,— for some men consider a horn an ornament,—but after seeing a herd of polls together for a little while their prejudice has usually been overcome. We have been breeding horns partly from necessity, but chiefly because we have not thought much about the matter. The horns could all be bred off from our domestic cattle, and I believe that they will be, when public attention is sufficiently brought to the subject. The polled breeds of Scotland and England have been gradually built up because of their superior merits becoming known and acknowledged by the farmers in general in the localities where they were at first bred only by the few.

It is claimed that removing the horns from young calves for only a few generations, and retaining only those which are hornless, will establish the no-horned character. I cannot, from my own experience, vouch for the truth of this, but there appears to be authority for the assertion. The removal of the horns from a steer calf, while they are attached only to the skin, cannot be a more painful or more dangerous operation than the universal one of castration. A polled bull of pure blood stamps his hornless peculiarity upon his get with remarkable power. I could read you letters from correspondents who have crossed polled bulls upon their herds of horned cows and obtained ninety per cent. of polled calves; in some cases more. I have found that from such crosses the heifers are nearly all polled; the occasional horns coming out, as might be expected, more often on the bulls. I make no claims for the polled breeds above others except because they are hornless, but on this account more desirable as domestic animals. The Galloways and Angus — particularly the latter — have, however, recently come to the front in the prize rings at the fat-stock shows, both in Europe and in this country; and the Norfolk and Suffolk Reds, besides being good beef cattle, are, many of them, most excellent dairy animals. The handsomest herd of cattle, according to my taste, that I ever saw, was a herd put in quarantine last year, at Waltham, by two Englishmen who brought them over. Another herd, said to be even better, but which I did not see, was imported later by Col. J. B. Mead of Vermont. The prices asked for each herd were thought by our New England breeders too high, so they were allowed to go West, where their peculiar merits are better appreciated.

If there is anything that I would specially keep clear of, it is a public excitement, a contagious fever, or, as it is now more fashionably expressed, a " boom " in anything relating to agriculture, whether it be in horticultural novelties, silkworm trees, fast horses, blooded cattle or poultry. I do not believe that an investment of seven thousand florins in a single tulip, or forty thousand dollars in a single cow, was ever a good investment for any sane, sober man; and I believe that the newspaper press of the country is at fault, when it lends its influence to parties who have a pecuniary interest in working up booms. Men fall into holes often enough without having holes dug expressly to entrap them. Were I in favor of booms, I think I should know about how to go to work to set one going. If it were in cows, I would select a good one, and feed her for a week or two as I would a hog for a premium,—almost to the point of death. After I had got her well under way, I would set my hired man to get up a milk or butter record; paying him, of course, in proportion to the size of his report, for a single week's spurt. Then I would write letters to all the leading papers, setting forth the wonderful powers and accomplishments of the Queen of Humbug Hollow, and accompany the correspondence with an advertisement of a half-brother, or a few sisters, cousins or aunts of my wonderful cow. If I had a few trusty friends that would swap with me even, a bull or a heifer, and call the prices a good many times the real value of the animals, and would get such sales into the papers too, it would probably help along the boom. I don't say that anybody else ever thought of such a method of getting up a boom. This may be an original idea.

The price of polled cattle a few years ago in England was just about what they were worth for beef; but since their merits have become more widely known, and especially since the Americans began to import them, the prices have materially advanced. Good polled cattle cannot be imported and sold now for less than from $200 to $500 each; but a few breeders, who could afford to wait for their returns, could establish herds of pure polled cattle, either of the beef or milking families, and after a few years be able to sell young bulls, at prices which farmers desiring to breed the horns off from their own herds could afford to pay, and at prices, too, which would well remunerate the breeders.

There are also a considerable number of polled cattle scattered through the country, particularly in Vermont, Canada, Pennsylvania and Virginia, which may be termed common cows, as they have no recorded pedigree or written history, but many of them are superior dairy cows. It is not an uncommon expression among cattle men that they never knew a poor no-horn. I could not say that; but I know that I have seen many noble-looking polled cows among the herds of so-called common cattle in the vicinity of Philadelphia, Washington, and Harper's Ferry in Virginia. The valuable breeds of Europe have all been created by selecting from the common stock of the country and breeding it for a number of generations with skill and good judgment.

I have not a word to say against good pure-bred stock, but all the good qualities are not gathered inside the lines which separate the so-called pure-bred cattle from the so-called common cattle. We have a great amount of valuable breeding material among our common stock that is well worthy of being retained and improved. It is of no use to attempt to hoot down the "general-purpose cow,"—the large, hearty, peaceable cow, that doesn't want nursing; that will yield, when well fed, a large pail of rich milk; and then, when no longer wanted for the dairy, will make a carcass that the butchers will not turn away from. The time is coming when there will be a breed of American cows that will do credit to the name. It is the pride of the Yankee to improve everything which he puts his hands to. The American general-purpose cow of the future will, I trust, be a cow without horns.

The CHAIRMAN. I think you will be satisfied, from the character of the paper which you have heard read, that the author is competent to answer any questions appertaining to the dairy interest that you may be disposed to ask, and I think there is enough in this subject to call out some profitable discussion.

Mr. PALMER of Stockbridge. I would like to ask the gentleman if the breeds of polled cattle are as good milkers as short-horns and Holsteins.

Mr. CHEEVER. The Suffolk and Norfolk red polls, bred in the south of England, have a high reputation as dairy cows; and the animals that I have seen, some of them, indicated it very much by their appearance.

Mr. A. A. SMITH of Coleraine. I do not rise to discuss any subject presented in the paper, but simply to relate a fact which came under my observation in regard to the docility and quietness of the polled Angus. I was at Waltham, at the quarantine, last spring, and I saw several herds of cattle there. Being acquainted with one of the men who had charge of the cattle, I asked him about the docility of the different breeds, and he made this statement: That among the most dangerous animals that were quarantined there were the polled Angus. I do not know that it is so; but, nevertheless, that was the statement made by that man. I am very much inclined to hope that this audience, notwithstanding the good authority that we have had in this paper from

Mr. Cheever, will not go away with the impression that a polled Angus bull cannot be made to bunt, if he cannot hook; that he cannot be made a quarrelsome animal with other cattle. So far as the quietness of the cattle is concerned, I believe that the polled Angus are as nearly equal to the short-horns as any breed, but I do not believe that the fact of their having no horns will affect materially their disposition. That is made by the care which any animal has.

Mr. Gold. I have a personal incident that I recollect, which is suggested to me by the history of short-horns and by the Kentucky discussion. Cassius M. Clay, well known to you all, several years ago was present at a convention where the qualities of the short-horns of Kentucky were discussed, and he was asked how much milk those short-horns gave. He was entirely taken aback by the question. The idea of its being a matter of any importance how much milk a cow gave seemed to strike him as something entirely new. He hesitated, but very soon recovered himself, and said he did not know exactly, but was quite sure, in fact he was positive, that he had known them to give as much as half a bushel!

Major Alvord. From what little experience I have had in the care of horned cattle of two or three different breeds, I must say, that to me the horn seems to be simply an ornament; and it certainly has been to me an expensive ornament for the cattle to have. I could reckon, as everybody here could, in a few years' personal experience, many casualties attributable solely to the horns upon cows and bulls; and while Mr. Cheever has presented the subject in the light of a special breed without horns, the question at once arises,—Why have horns on any breed? There is no need of it. We can keep our breeds as distinct as they are now and dispense with horns. It has been done, and it can be done again. My father-in-law, who was a breeder of pure-blood Devons for many years, getting his stock replenished from an adjoining farm where they were directly imported, never had a horned animal upon his farm; and after some years, during which he removed the horns of all his calves, he bred a pure Devon bull without horns, whose calves—about four out of five—had no horns; and when a calf appeared with horns, a sharp knife, carried in the pocket, took out the button with no more injury to the animal than the clipping of a lamb's tail, and much less pain than is caused by the castration of male lambs. This was tried with Jerseys. I found the Jerseys especially, because of their nervous disposition, injured each other with their horns, and I took to removing the horns from my Jersey calves. I raised a good many and sold a good many registered Jerseys without horns. There is no question that the fact of being hornless aided in the prevention of casualties, although of course I do not believe that the disposition of those animals was materially changed; nor would you notice, in the case of my father-in-law's herd, which were hornless, and that of his neighbor, which were horned in the regular style of the Devon (although there was a very marked difference in the appearance of the animals), any difference whatever in the general characteristics and disposition of the two herds. Certainly, a Devon bull that I very well recollect, born without horns, as well as a younger one whose horns were removed, were not specially pleasant companions to handle without something between the person and the bull in the way of a stick. But still, even in this case, there is no question that a bull without horns is not so formidable an antagonist as one that has a good pair of horns upon his head. It is simply a matter of style and fashion. If anybody objects to having horns upon his cows he can do without them, just as he may have short-tailed lambs as well as long-tailed.

Mr. SMITH. I would like to inquire whether there is not a standard of excellence which governs not only the registering of the animals but the awarding of premiums at the great exhibitions, and if there is not, also, in the distinct breeds (Major Alvord or some other man can answer the question), a standard of excellence to govern in the tests? In the Jerseys, in the short-horns, and in all those breeds which have horns, among the points, is it not prescribed that the horns shall be of such shape, such length, etc.? And how are you going to compete with Jersey cattle with your hornless Jerseys?

Major ALVORD. You cannot, of course.

Mr. SMITH. I do not believe in interfering with nature in the way suggested by my friend Major Alvord. I would as lief meet a bull with a good formidable pair of horns as one without any.

Mr. Sessions. It is a small matter to talk about, but at the same time I have known the horns to save the life of a person who was attacked by a vicious animal, in two instances. In one case the animal was endeavoring to gore a person and his horns struck the ground on each side, and the creature without knowing it, worked each way and all around with them, but did not injure the person. It was a narrow escape. In the other instance, the person attacked grasped the horns of the vicious animal and saved himself. If he had not had the horns to take hold of he would probably have been killed. I believe nature provides the polled Angus with weapons of defence, and they are able to take care of themselves and their neighbors just as well as if they had horns.

Mr. Buzby. I have one cow that has raised a splendid calf without any horns. I want another just as soon as I can get one, and you have enlightened me, so I will soon have a pair of Jersey steers.

Mr. ———. The speaker says he would advise dairymen to divest their calves of horns. Would he advise farmers to remove the horns when the calves were to be kept for their own use, and what would be the process of removing the horns?

Mr. Cheever. Part of that question has just been answered by Major Alvord. A sharp knife takes the knob right off before it is attached to the skull and that is the end of it. You have only to cut through the skin of the young calf and remove the horn so that it cannot grow again.

Question. It does not start from the skull?

Mr. Cheever. No, sir; it does not start from the skull but from the skin. In answer to the second part of the question, and speaking for myself alone, I would have no other animal than a polled cow in my herd, if I could help it. I have never tried to cut out the horns to any extent whatever; I do not like to do even that. I was not breeding in that direction. I was trying to breed the horns off by crossing with polled cattle. It came slowly, but I got them.

Secretary RUSSELL. Fourteen years ago, at the time of the boom, so called, in Ayrshires, I was asked to collect a herd for Mr. Pierre Lorillard, to supply milk for thoroughbred colts. This was my first acquaintance with Ayrshires; I knew very little about them, and I found that they had the reputation of being very quarrelsome. They had thin, light, waxy horns. I did not care much about the horns; and in going through Connecticut, where I bought thirteen or fourteen cows, I found that I could buy a cow that had knocked off one or both horns in fighting, at from $100 to $200 less than the price that was asked for cows with horns that were still in good preservation; and nearly all the cows that I bought had lost one or both of their horns. Now, there is nothing in that, except that if it had not been fashionable to have horns those breeders would have got full price for their cows; and if horns were of any value at all we did not understand it so, and we would just as lief have them with the broken horns as with whole horns. Those cows became the basis of the Rancocas herd, at Mr. Lorillard's farm in New Jersey.

Now, as to the strength and use of the horns on the head of a bull, I have probably had better opportunities to see them in use than any man here present. I have seen a bull kill five horses within twenty minutes by my watch; and one of those horses, with a stout man on his back, the bull took on his horns and carried as far as from here half-way across this hall, and dashed horse and man against a barrier six feet in height. He raised the horse and the man up to the edge of the barrier. The action of an animal that knows how to use the horn is as deadly and quick as the action of a swordsman with a sword. I have seen a matador, as they call the man who kills the bull in the arena, dancing about, dodging the horns of the bull, waiting to get his thrust in the neck; it was quite like fencing. I have seen an expert matador thrown down by a bull and a horn run through his silk clothing, across the skin, so as to show blood to the gaze of the delighted audience; and when a man has got a contused wound from a bull's horn, say, for instance, in the small of his back, he is one of the most useless human beings you ever saw.

Mr. I. L. Cragin, of the Cragin cattle ranch in the Indian Territory. I suppose the habit of admiring pretty horns, graceful horns, etc., has as much to do with the idea that they are necessary on the heads of cattle as anything. I know that when Devons or Ayrshires are brought to the shows, their owners are very careful to have the horns polished up, to answer the demand, as our friend Smith says, of the people. We have a range in the West, and I suppose it is well known that most of the polled Angus cattle have gone West; there are very few of them left in this section. One of the greatest dangers we have is the use of the horns upon Texas cattle. They are very long, very sharp, and those Texas cattle use them very savagely whenever occasion requires, and many deaths occur among the cattle from the results of being hooked when they go down to drink, or in any other contest. Our object has been to get rid of that danger, and we have been at the expense of importing eight polled Angus bulls. I never saw handsomer creatures; they are jet-black. Our neighbors around us have had the use of them for two or three years. They are the most docile animals we have on the range. Our boys go out and take them by the ear and can lead them anywhere; and we expect, by cross-breeding on our cattle, to greatly modify the wild disposition which many of our bulls have. I mean, particularly, the Jerseys; for I have had a good deal of experience with them, and have been obliged to give them up. Their obstinacy was such that they spread terror among my men. But with the polled Angus I have no trouble of the kind. I have met several herds of these animals and the universal testimony was that they were the most docile animals ever met with. I have seen very few of the cows. Another feature is, they mark their progeny very strongly. I have seen a herd of cows without horns, the result of a polled Angus bull; and, as a general thing, they were jet-black, although, in many cases, they came from white and speckled cows. Occasionally you will see one with a white spot, but very seldom. On several ranges I saw quite a number, and they were all strongly marked. As to their milking qualities I know nothing, — I don't think with us the question has ever been asked; but they exhibit the finest points for beef. That is the element that is looked for, of course, in the West. But so far as docility is concerned, my impression is it is beyond dispute. I think they are perfectly docile.

Mr. Grinnell. I am breeding polled cattle. It will be a long time before I shall succeed in getting them. I am doing it in this way. Out of a herd of twenty grade Jerseys, I have six that have one or more horns knocked off. They will become polled if they continue fighting long enough.

Mr. Robbins, The late R. M. Curtis of Sheffield, if he were living in this day, would be a strong advocate of polled cattle. His mode of removing the horn was by searing it with a hot iron when it first appeared. He was satisfied that it was beneficial, and was so strongly in favor of it that he wished a premium might be offered by our society to promote the practice. He believed that it would save the lives of human beings as well as of cattle, and that the growing of the horn detracted somewhat from the strength of the animal. He did not think a calf was injured in the least by his method of removing the horn. He said that as people became accustomed to seeing cattle without horns, they would value them as much as cattle with horns.

The Chairman. I remember Mr. Curtis very well. He was one of the earliest members of this society, and very active up to the time of his death. I remember very well that, within a year or two of his death, he was anxious that this society should take some measures to promote the getting rid of the horns of cattle by the same method which he had practised with more or less success. I don't remember exactly what it was, but I think it was searing with a hot iron when the animal was very young.

Mr. Pierce. I am getting to be something of an enthusiast over the no-horn idea. I have been breeding polled cattle for several years from stock purchased of Mr. Cheever. I have fourteen no-horns now, mostly young cattle, and they run together like sheep. You can drive them through a narrow lane and they will crowd each other, but will not do any damage. They are perfectly docile and do not stand in any fear of one another. If one is drinking, she will let the others come up and crowd around, and they will drink together, as several can get their heads into the tub at once.

I have three horned animals, as I have said, and they can only drink one at a time. There is one advantage. Then another advantage is, as I have mentioned,— turn them out together and they have no fear of each other; they cannot injure one another. And then there is a great deal of comfort in working around them; there is no fear of your eyes being put out. I have got a four-year-old bull that, when I take him out, I have to hold him with a stick to keep him away from me. He is strong and active, and I should not want to fight him single-handed; but I have the feeling, all the time, that while that bull has the power to knock me down, if he can get a chance, he has not the power to tear me to pieces. Although I am not safe, in the sense in which I might wish to be, there is not any danger from him compared with what there would be if he had horns.

Remarks have been made here indicating that the speakers thought that hornless cattle can`fight. The most they can do is to push each other. I was foolish enough to turn this bull of which I have spoken, when two years old, into a pasture where there were two yoke of oxen. They were large Durham oxen and got the advantage of this bull when he was two years old, but I very soon found that he was able to fight those oxen anywhere. But there was one thing more: The oxen marked the bull, but the bull did not mark the oxen; he did them no damage at all. He simply got the advantage of them because he put his head under their breasts, and, being lower than they were, he took them off their forward feet and turned them; but he did not mark them, and could not.

Mr. Cheever. If I had quoted from the authorities that I might have raked up in my library, I could have given more than an hour's time to accounts of injuries from bulls with horns; but my object was to draw attention to the subject, and suggest that it was possible to breed off horns, and to give people a chance to think over the matter. I know that such a thing can be done as to breed off horns, and that pure-bred bulls will breed, in a large majority of cases, hornless calves. If you turn ordinary cattle into the barn when their coats are wet from standing in the rain, when you go near them, they will be likely to strike you with their horns when they shake their heads. I have received a hit with the end of a horn on my face, with no evil intention on the part of the cow. Many times people have had their foreheads hurt badly by the accidental motions of the cattle they were tending. Horns are simply useless; they are allowed to exist because they are in fashion, and because we have not thought to do otherwise. A polled cow can be tied in a way no other cow can be. I secured the greater part of my cattle with stanchions; and even bulls can be put in stanchions.

Mr. SMITH. I would like to have Mr. Cheever state whether he believes that taking the horns from Jerseys, short-horns, or any other breed of cattle, will change the disposition of that breed of cattle? I don't believe it.

Mr. CHEEVER. If all the dirk-knives and pistols were taken out of the hands of people, would they not be more peaceable than they are now? The temptation to use a pistol, a knife or a horn is very strong, upon the impulse of the moment. You do not find stripes up and down the flanks of polled cattle, or the hair gone in spots; and it is rarely that I see a herd of twenty-five or thirty cattle with horns that I do not see some of them marked in that way. Polled cows running with horned cows will show a different disposition from the other cows in the herd, as a rule. I had one polled cow that was bought as a heifer years before I began to breed, and I put her in a herd of horned cattle. She was pitched around and marked and scratched until she got tired of it, and when she grew older and found out what she could do, she learned to take the other cows under the shoulders, and they would yield to her. She got up the courage of a two-year old heifer, and with the courage of a two-year old heifer she whipped the herd. She was not one of the creatures that will leave off when they get through. She became so vicious that I kept her in the barn the last year. She was not one of those that had been brought up among dirk-knives and pistols. I had another cow, one of my own breeding, — one of the largest cows I ever bred. She got to be four years old and she would turn out for any calf that attempted to push her away. She didn't seem to have any idea of fighting or bunting. Although the largest cow in the herd, she was what we would call an underling. I bought a one-horned cow and put her into the herd, and that purchased cow, like all other cows, wanted to try her strength and see which was going to be mistress, and which was going to yield. She tried this big cow, and she annoyed her repeatedly by hooking, driving and pushing her. Somehow or other that cow got her grit up. One day I happened to hear a noise and I looked up in the pasture. There was a high stone wall along the lower side of one field, and against the upper side of another. I looked up there and saw a big gap in the wall, with the horned cow standing below the wall and the no-horned cow standing above it. They were looking at each other through the wall. The gap was made at the time the horned cow was thrown over that wall. They were both the most surprised animals I ever saw. There was no more trouble of that kind. That cow found out that she need not turn out for any other cow unless she cared to, and she took care of herself. But when the animals are all bred with no horns, there is no temptation to quarrel and try to injure each other.

Adjourned to seven o'clock.

Evening Session.

The Board met at seven o'clock, when a lecture was delivered by the Secretary, on The Climate of Massachusetts.

At the conclusion of the lecture, on motion of Mr. Grinnell, it was voted that an hour be spent in the discussion of the subject of Forestry.

The Chairman. It has been very pertinently suggested that perhaps the audience would like to hear Mr. Russell open the discussion on Forestry in any manner he may choose.

Secretary Russell. I do not want to talk about things that you all know about. I cannot take up a new subject to-night. And then, I do not want to get into any dispute. There is Mr. Manning. He is the man to open the discussion. He is an eminent authority.

The Chairman. Mr. Manning is authority on forest trees and tree planting.

Mr. J. W. Manning of Reading. I will say, in regard to maple seeds, about which you heard this morning from Col. Wilson: Our red maple (*Acer spicatum*) blooms in spring; it is one of the first red blossoms we see; the seeds drop late in May or early in June, they come up early in October. The silver-leaf maple (*Acer dasycarpum*) blooms in May and drops its seed in June. I have sowed the seed very late in June, and in fourteen months from the time those seeds dropped off, they produced trees seven feet high and an inch in diameter. That is not uncommon. We have many hundreds of those same seeds now growing. The rock maple (*Acer saccharinum*), which is the most popular maple known and the most in demand, holds its seed until September. The striped maple (*Acer Pennsylvanicum*) and the mountain maple or cluster maple (*Acer spicatum*) also hold their seeds until September. Then there are two or three European varieties that we know about,— the Norway maple and the English sycamore maple, for instance,—which hold their seeds until September. They can be planted then, and will come up the next year.

It is often said that you must wait until June to transplant evergreen trees. I have handled evergreen trees for a great many years. I find it is a good plan to begin to transplant as soon as the frost is out of the ground, and I work away into June sometimes. I have had success in every instance when we have had a favorable season. We cannot guarantee trees against extreme drouth; but, if handled carefully and skilfully, the probability is that nearly all will live, under favorable conditions. I have recently been planting seeds. I sowed a bushel of chestnuts a few days ago, acorns and white-ash seed, and the seeds of various other seeds and plants, for growing next year and afterwards transplanting.

The call for nursery-grown trees, to extend forests, is increasing every year. There is an increasing demand for the white pine. They are very safely handled if you take up a small ball of earth with them. They can be removed at almost any season of the year, but it is safest to handle small ones. There is a great difference in the success of planters. I once sent two thousand white-pine trees that came out of the forest very small; the buyer sent me word that he did not save a single one. I picked over the lot and sent him the largest; the smallest I transplanted myself and saved more than half of them. They were re-set again, and not more than one in a hundred died. In transplanting forest trees, if you get seedlings, it is best to transplant them in nursery rows one or two years before you transplant them into the forest; then you can make almost every one live.

The CHAIRMAN. Perhaps the most information may be drawn from Mr. Manning, by questions from the audience. I would say to those who were not here during the day, in explanation of Mr. Manning's remarks, that the question was raised this morning, by Col. Wilson of Boston, in regard to the time at which maple trees drop their seeds. He asked those of the audience who knew what that time was to raise their hands. The result was, that Mr. Manning, I think, was the only man in the audience who held up his hand.

Col. WILSON. I saw four who held up their hands. No doubt there were others who knew, but they were so modest they did not want to show their hands.

The CHAIRMAN. Any question that any one has to ask Mr. Manning, he would be very glad to answer.

Mr. MANNING. I would like to ask if any one can tell, with any definiteness, how often a white pine will bear a crop of seeds? More than fifty years ago, I remember hearing my grandfather say, that about once in four years you would get a good crop of white-pine seeds, and then there would be but very few for three years. I did not think much about it at the time, but four years ago I went to the Rocky Mountains. I came home by the way of Lake Superior, and I saw the white pine in a great many places on that trip. I travelled more than seven thousand miles that year and I did not see a white-pine seed or cone. This year I have been almost to the Black Hills, and I came home through a section of the country where white pines grow,—in Michigan, Iowa and Wisconsin,—and I saw but very few white-pine seeds. Between those years, '79 and '84, there was a very heavy crop of white-pine seeds. The rock maple does not bear a full crop every year. Last year there was a very heavy crop of rock-maple seeds; you could sweep them up by the bushel.

I have trees of this year's growth from six inches to a foot high. The rock maple and the Norway spruce are bearing very poor crops this year. It is quite a study to know how often to expect these crops.

Mr. CUSHMAN. I well remember some years ago being told, by a farmer in my vicinity, that the white pine bore seeds only once in three years. He remarked that some trees in the forest would bear seeds every year, but an individual tree would bear its seed only once in three years.

While I am up I wish to allude to the highly interesting paper read by my friend, Mr. Slade, this morning. Perhaps I was more particularly interested in his paper than many in the hall; knowing, as I do, quite intimately, the cases that he cited, of the white pines that had been planted and grown up, many of them, in my native town of Middleborough, where many of those plantations that he mentioned are situated. We held a Farmers' Institute, of the Plymouth County Agricultural Society, on the 14th of last month, in that town; and the local judge of the town, who gave us the address of welcome in the morning, after a careful and thorough investigation of the industries of the town, stated to us that last year the sales from white-pine lumber for box boards, mostly, amounted to one hundred thousand dollars. It has been more in more prosperous years. So, gentlemen, you can see that in one town in the Commonwealth the white-pine forests must have netted an income—which has mostly gone into the pockets of farmers — of one hundred to one hundred and fifty thousand dollars, and that year after year. Does it not pay to encourage an industry that will bring one hundred and fifty thousand dollars a year into the pockets of the farmers of a single town in this Commonwealth? I know, sir, that it pays to transplant white-pine trees. It has been a branch of my farm work from my boyhood, to cut down the white pines and market them. I have also done something in setting them out and transplanting them, and I think Mr. Slade made a very good showing of the profit of the business. I think if he had advocated setting the white birch with the white pine, he could have made a better showing. I have had good success in planting the white birch thick amongst the white pine; setting the white-pine trees ten feet apart in rows each way, filling in with the white birch. The white birch seemed to aid and protect the white pine as they grew up together.

Mr. SLADE. Do you sow white-birch seed?

Mr. CUSHMAN. I have never been compelled to gather any white-birch seed and sow it. I have always had an abundance of white birches springing up on the edges of the woodlands; and I could go and collect a cartload and set them out, and do it cheaper than I could get them by sowing the seed. So I do not know anything about raising white birches from the seed because I have never been obliged to turn my attention in that direction. But in from twelve to fifteen years from the time of setting, I can begin to cut the wood, which is valuable for many purposes. White-birch wood is very good firewood when treated properly. It makes the very best of coal wood. There is always a market for white birch. And when the white birch is planted with the white pine, there is no necessity of pruning the pine; the white birch seems to force the pines up into the air; whereas, if there are no white birches, as was remarked by Mr. Slade, the limbs are thrown out horizontally. So that by planting the white birch and the white pine together we secure a better growth of the white pine and better shaped trees. I cut last winter, and I am to cut this winter, a white-pine forest that I played in when a boy; and my father told me many times, that a year or two before my birth he raised corn on that land, and sowed white pines just before my appearance. It seems almost incredible to me how rapidly those trees have grown. I cut fifty-three cords of logs from a very few rods over an acre; and those of you who are good at guessing can tell how many years they have been growing. So it is certainly an industry that is worthy of our attention.

I believe the white pine is the very best tree for us to grow. My experience in selling wood to wheelwrights has not been very flattering. I cut my wheelwright wood—hickory and oak—and carry it to the mills, and pay the sawyer's bills, and then I am plagued to find a market; I have to keep it a year, and then perhaps make a barter trade. But the white pine has a cash value any day in the year. There is no trouble in turning a white-pine forest into cash at our pleasure.

Mr. Kline. What varieties of forest trees should be planted?

Mr. Manning. Plant the red oak, plant the white ash, plant all the evergreens you can think of. It would be well to plough the land before you plant, but you need not even do that. Plant larch trees, plant maples, plant almost anything; but plant them thickly, so that they will help each other along, especially along the seashore, where they are exposed to high winds. Plant them very thickly; no matter if there is a tree in every six inches square. Let them grow up together; one will help the other, and you can thin out what you do not want. It is important to do that thinning out in season. I was once through that wood lot of which Mr. Slade spoke, with Mr. Robert Douglass of Waukegan, Ill., who grows more trees from seed than any other man in America. I went out to Mr. Richard S. Fay's in Lynn, and saw his trees; and then I went to his brother's at Wood's Holl, and he showed us larch trees on a hundred acres that were anywhere from twenty to fifty feet high, the seed of which he had sowed on the sod in a pasture. He showed us pines that were fifty feet high and more, that had been planted twenty-nine years. Norway spruce and white pines had come up to that height. Those trees he had planted on the bleakest part of his land, where the sea winds come up strong, and he had succeeded in getting the larches and other trees up by planting them very thickly. There had been a forest of oaks beyond that line, but they would only grow up to a certain height; the winds were so strong that they stopped their growth. But when this forest had grown in front of them they began to spring up, and grew thirty or forty feet higher. The lesson is a very useful one, seeing they were set out at so little expense. I agree with the suggestion in regard to planting the white birch with the white pine. The secret of transplanting trees is to plant them thickly and let them hold each other up.

I have seen those timber shelters in Dakota and various other places. In 1875 I passed through Iowa and I did not see but three or four timber belts at that time; but last summer I was across the country in various directions, and in places where, as far as the eye could reach, I could not see anything in the shape of a forest nine years ago, you can go a hundred miles and scarcely look anywhere without looking into one of those timber belts. They obscure the whole view, except occasionally you may catch a glimpse through. Those trees are twenty, thirty and forty feet high, and afford a shelter to buildings and to the crops, even. It is a wonder that it was not found out and practised long before. They grow the silver-leaf maple, the cottonwood and the black walnut from seed, also other varieties of trees. They plant the Scotch pine, the Norway spruce, the Scotch larch, and they are all successful.

Mr. CRAGIN. Would you plant pines for timber very thick?

Mr. MANNING. Oh, yes; plant them very thick. They plant them about four feet each way. They cultivate them as they would corn. Where they cultivate them they are very sure of success. I have seen, at Mr. Wheelwright's place at Beverly Farms, trees sixty or seventy feet high, where it was not supposed a tree could be made to grow. Each tree originally occupied about a foot of space; and you will see to-day, under those trees, little shrubs four feet high, that have got overshadowed and dwarfed. Our American basswood is one of our best trees.

Mr. GRINNELL. Mr. Chairman, please to call on Mr. Hadwen to speak in relation to the Scotch larch.

Mr. HADWEN. I have had a little experience with the Scotch larch, as well as with a good many other of our trees; and for timber, and for timber purposes only, perhaps there is no tree that is more worthy of the attention of planters than the European larch. Several years ago I was building a barn, and I wanted some sticks of timber that would square eight by ten inches, and thirty feet in length. I went to the lumber yards and they informed me that they could get such timber, but it would require some three weeks' time, as they would have to order it. As I came home I looked at some Scotch larches that I had planted twenty-six years previous, just on the margin of my land bordering the highway, and I came to the conclusion that I had the timber on the spot. I told my carpenter I had got the material directly in front of the house. We cut twenty Scotch larches that would square eight by ten inches, that had been planted twenty-six years. It is well known to all the gentlemen present that there is no tree that carries its size so uniformly well as the Scotch larch ; and, in relation to its durability, of course we have not had time in this country to know how long it will last, but it is well known in England. They have built men-of-war of the Scotch larch ; and they put that timber in the docks at Liverpool, where it has outlasted two sets of oak. I have no doubt that the Scotch larch, on rich land, — or it may be on poor land, — is as well worthy of the attention of tree-growers as any tree that we have, for purposes of timber.

I think you know, Mr. President, the fondness I have for trees. I have spent a good deal of my lifetime in planting trees. I do not regret a single day or hour that I have expended on the public grounds where I have been, or on my own grounds, in planting trees for ornamental purposes, that hereafter will be worth something for any purpose for which they may be desired. Among these trees, perhaps, there are none better than the ash, the hickory and the oak. But in planting the ash, you must select a soil with considerable moisture. It is no use to plant the ash on dry soil. It must be a deep and retentive soil, with considerable richness, in order to have the ash thrive. Under these conditions it is a tree well worth planting, because we know the ash is worth something after it attains the size of perhaps four inches in diameter. And then there is the oak. Perhaps no statelier tree grows, or a tree that is more beautiful in its foliage in the autumn. George Sumner, the brother of our late Senator Sumner, when visiting Russia, went to St. Petersburg, called on the American minister, and said he was desirous of seeing the emperor. The minister informed him that it was a very difficult matter for a private citizen to gain audience with the emperor, but he pressed him so hard that finally he said he would learn if it was possible. A day or two after he was informed that the emperor would be very glad to see Mr. Sumner, and his carriage would be at the minister's residence at such a time. Mr. Sumner was in readiness and went to the palace, and there was presented to the emperor of Russia. He told him that he had called for the purpose of presenting to him an acorn that he had gathered from Mt. Vernon, the home of Washington. The acorn was very graciously received, and the emperor said to Mr. Sumner, — "If you will accompany me to the garden, I will plant the acorn with my own hands," and it was done. A number of years afterwards, when the Grand Duke Alexis visited this country, he brought with him some leaves from the oak that had grown from this acorn and presented them to Senator Sumner.

In regard to planting the oak, it is readily grown from the acorn, but it has a root whose tendency is to go downward. It is a better way to plant oaks in nursery rows, or in beds, and then, in transplanting, to plant them in rows after attaining one year's growth, and have at the bottom of the trench a board, so as to prevent those roots from going down very deep, and cause them to strike off in a horizontal direction. There is no sort of difficulty in planting the oak or the hickory.

Then there is the tulip tree, which has not been spoken of, which is one of the most beautiful trees that grows in New England. It has a very succulent root and it should be planted on a board in order to be transplanted afterwards with safety.

I do not desire to take up your time, for I know you are getting tired; but I have had a trip this afternoon about this beautiful town; getting, I might say, my first glance at these old hills of Berkshire, which seem to me to be covered to the very tops with fine ornamental and useful trees. I noticed among them the pine, the oak, the maple and the elm in great abundance.

The CHAIRMAN. I am very certain that Col. Wilson did not tell us all he could tell about forest trees this morning. The audience would like to hear something further from him this evening.

Col. HENRY W. WILSON. I do not feel that it is quite right, when a man is in a convention like this, to be backward in doing his share. I have this disadvantage, you understand, gentlemen, in attempting to talk upon the subject of raising trees, that I have had no experience in that direction; and I would give a great deal if I had the experience of my friend Manning. It has been my privilege through life to derive from other people the fruits of their experience, and what I give you, you understand, is not what I have learned from raising trees myself; but I have endeavored to associate myself with men of experience, of good powers of observation, and I have tried to derive from them all that was good and useful, and it is by that light that I am guided in my conduct and in my business.

The discussion this morning was somewhat desultory, in so far as I was concerned, and I am fearful that the people went away with a false impression as to certain particulars. I did not attempt to create a party, as I might say, in favor of raising what is called "wheelwright stock," but you will remember, some of you, that I alluded to the fact that Mr. Slade, in his very entertaining paper, had gone quite extensively into the subject of raising the white pine, and I wanted it understood that there were other kinds of trees which, in other places, might be raised profitably, and I have known gentlemen who have realized great profit in raising the stock which we call "wheelwright stock." When a tree suitable for such purposes is four, five or six inches in diameter, it has quite a material value, if a man is where he is near a market; if he is at a distance from a market, it is not so easily disposed of. I admit that there are disadvantages, evils and troubles incident to all things in this life. You will find them in cultivating forest trees as much as in raising sheep or cattle, or any other thing that occupies the attention of our farmers.

Now, there has been something said about the Scotch larch. I have had an opportunity to think over the successes of gentlemen in cultivating that tree. As has been said by Mr. Hadwen, I think that the peculiarity of the Scotch larch is that its growth is so uniform that you can get a stick of timber that will square almost as much at the top as at the butt. Consequently, there is less waste material in preparing it for timber purposes. It is an exceedingly durable timber, also. The congener of it is our hacmatack. The American larch is not so durable timber nor so useful as the European larch, but I have known cases where it has proved very durable timber when properly grown and seasoned. If the tree is cut when small in size, before it has become sufficiently matured, it will decay rapidly. Some people noticing that fact may have judged harshly of this tree and concluded that it is overestimated. Doubtless there are some here who remember the recorded instance of the Duke of Athol, who owned the northernmost part of Scotland, to which you alluded, Mr. Secretary, which was saved from the encroachments of the invaders simply on account of the poverty of its soil and the roughness of its climate. He found himself with a title and a long pedigree, but with a purse altogether too short to support that pedigree; and, being a prudent man (this was 130 years ago), he cast about to see how he might wisely make use of his estate, and his resort was to the European larch. In some years that nobleman planted from a million to a million and a half, and I think even two millions of trees, until his plantations covered tens of thousands of acres. In recognition of his great success in the cultivation of that useful timber, a ship of war was built, and every stick of timber in it — every knee, carling, keelson and the very keel — was shaped and formed from the larch timber that grew on his plantations. From that estate was sold continuously for many years as much as 18,000 or 20,000 loads of timber per year, affording a princely income, which has been the means of retrieving the fortunes of the house of Athol. What can be done under the most disadvantageous circumstances, in the bleakest and most unpromising part of this world,— for there is no place in New England that will compare for bleakness and barrenness with the northern part of Scotland, — can be done here. The success which has attended the raising of trees in that country will furnish encouragement to any one who will attempt it, in a small way or in a large way, as he may see fit, but do it thoroughly.

Now, this matter of cultivating forest trees must be done just as my friend Slade cultivates strawberries, or as another man cultivates apples. It must be done thoroughly; no half-way measures and no foolishness. It will not do to merely go upon a side hill, dig a hole and stick in your seed or sapling and leave it. If you set out a tree, that tender sapling wants nourishment. It must be able to contend, when a sapling, for instance, with all the brush and trash that will grow up around it. I dwelt upon that sufficiently this morning and will not further it now.

In the course of the discussion this morning cases were mentioned where trees had been planted ten feet apart, because people had fallen into the error that they must be planted where they are to stand; but you understand that the whole value of a stick of timber is in its straightness and in its freedom from limbs in the lower part of its stem, and the only way to accomplish that is to make nature work out the problem and force the young plant to climb upward. That is done by planting the trees close together. I have never known any advantage to be gained by planting them nearer than four feet apart in rows either way. The fact is, that those who have achieved the greatest success in this matter have done it by tillage; by setting the plants where they have been able to run a cultivator through the rows, and do that for three or four years until the foliage is so completely spread over the ground as to discourage and eradicate all useless and noxious weeds and rubbish.

I know that there is much reason for an improvement in our New England towns, and by the roadsides, in the character of the shade trees. I notice as I travel up and down the valleys of New England that there is a great similarity in the trees that they plant by the roadside, if they plant any. I will say, to the credit of many of the interior towns, that there has been of late years a very marked manifestation of public spirit in the matter of planting shade trees. In one place they will set out the maple, in another place they will prefer the elm, and so on. Of course it looks exceedingly monotonous, and there is not so much beauty as there might be if there was more attention paid to variety. Although the maple when cut for timber uses is valuable, is not the oak far more valuable? And for firewood, of course, it is excellent; but it always seems to me a kind of sacrilege to look upon a noble tree as merely so much cord wood. We may have to burn it, but I would rather put a tree to some other use.

We can cultivate the black walnut in all places where the soil has strength. By our roadsides we find certainly as good soil as we find in the fields. In these places, there may be encouragement to plant the black walnut. It is easily raised; it grows to great size, and a black-walnut tree a hundred years old may be from four to five and six feet in diameter, and, cut up into lumber, it is worth a hundred dollars per thousand. It is the last years of the growth of that tree which give it its value. There seems to be some mysterious and peculiar property that is wrought out in the tissues and fibres of the tree by age. It is like the ripening of man. The last years of a true man should be better than any that have preceded it. And so it is with the structure of a tree. As the tree matures in its age, the sap wood hardens more and more until the extreme limit of age is reached. You will find in an aged tree that the sap wood is about the thickness of my hand, and the interior will be solid and durable, and when properly prepared for the market it will have the highest value possible to be attained for lumber that is the product of the temperate zone, and fit for the most skilful labor of the builder or the cabinet maker.

There has been a point raised about the maple. I want to explain how that came up. In the hurried manner in which I was obliged to speak this morning, I simply touched upon the maple. I should have described the maple as has been done by Mr. Manning, for there are several types of that tree. But the point I was coming at was, the certainty with which certain types of the maple which are familiar to us all could be grown; the seeds obtained, and within a year little trees started, thus accelerating the time within which you can get a fine growth of firewood. We raise one tree for one use, another tree for another use. It is within the power of all our farmers to set apart some portions of their farms which may be less valuable for agriculture than others, and have their little plantation of trees, where they can raise their own firewood speedily and satisfactorily and have it at their own hands. It can be made a very profitable crop for that use. The maple is not very valuable for timber, but it makes a very rapid growth. If planted thickly and cared for, it will throw up a fine, handsome top, and, of course, as it limbs out and is thinned, you will get a fine growth of wood.

This subject has hardly attracted the attention that it deserves. Some years ago, — I think it was as early as 1872, — I was called upon to advise as to the cultivation of some trees on the island of Nantucket, having gone there for some purposes connected with my business. After looking the place over, and observing the character of the soil and its exposure to the raking winds of the Atlantic, I advised the cultivation of the European larch. Some one else saw the people soon afterwards, and had their ear, — they were of that class of people of whom it may be said that those who have their ear last have their judgment; consequently, they attempted to raise the white pine, and did not meet with very gratifying success. They sowed the seed broadcast; there was no proper cultivation; they took no especial pains. Anybody who has been to Nantucket and seen those barrens there, knows that the circumstances are not very favorable for success. With no preparation, they sowed the seed over the land, and the result was a mere thicket of stunted trees. They seemed to squat down for a long time before they could get strength enough to send their shoots into the air. Now, the trees are being cut off. They have decided that tree planting upon Nantucket has not been a success. One gentleman, however, at my suggestion, within the last few years, has attempted the introduction of the larch, as I first advised, and when I saw him last spring, he told me that he had had so far very satisfactory success, although the trees were small. I believe if the cultivation of that tree is attempted there, they will receive a benefit from it.

There is another tree the cultivation of which I would recommend, and that is the catalpa. It is a quick and fine growing tree and furnishes wood of marvellous durability. It makes fine joiner work, and takes a good finish in cabinet work. I think it will endure in most parts of Massachusetts. They succeed in making it grow on those bleak plains in the West, and, I believe it can be grown here with success. It has been grown here, but how extensively I do not know.

I believe that if our farmers would cultivate one or two Russian mulberries about their houses they would derive a great deal of benefit and pleasure from them. They make a capital tree, with a fine head, excellent foliage; and when the tree is well-established it produces a sub-acid fruit, which is almost as luscious as the strawberry. It is within the power of anybody, anywhere in Massachusetts, even upon our hill-tops, to cultivate that tree and have an abundance of its luscious fruit, which is as large as the blackberry; not equal to it, but, as a substitute, where the blackberry cannot grow, there is nothing better.

I believe that the least a speaker can do, on an occasion like this, is to be well prepared and give proper attention to his topic. That I have not been able to do, having been called upon quite unexpectedly, and that will be my excuse for not occupying more of your time.

The CHAIRMAN. The audience are certainly very much obliged to Col. Wilson and would have been glad to listen to him longer.

Mr. MANNING. I would like to say a word about the catalpa. It is a tree that grows well and rapidly. When planted in rich land it bears one of the largest leaves you will find anywhere, unless you count the cabbage leaf. I have seen them ten inches in diameter.

Mr. GRINNELL. Is it hardy?

Mr. MANNING. I don't think the young tree is perfectly hardy; it will kill back a little. I set out one about seven feet high and it died down perhaps four inches, and the next year sent up shoots from half a foot to seven feet. I moved it in November and every bud started out. It is safe to move it any time either in the fall or spring. I believe when they get well established they are hardy. Mr. Douglass has planted several hundred acres of the white ash, the catalpa and some other trees, along railroad lines. He has taken a contract to plant nine hundred acres for one railroad company. They plough the land for him and he puts in the trees after it has been cultivated for one year. He tills that land for five years, and sets out twenty-seven hundred trees, and is to guaranty two thousand trees to the acre. He does that for the most marvellously low price you ever heard of. It is less than $20 an acre, the whole thing.

Mr. SLADE. Is there any more difficulty in transplanting the holly than any other evergreen?

Mr. Manning. I think there is more difficulty. I would take small trees and cut them down to the ground, plant them in rather damp soil, and mulch them very heavily with leaves. If you transplant small oaks or chestnuts and cut them off very near the ground, they will live very generally. It is better to get nursery trees, if you can, that have been transplanted frequently. I planted oaks, a few days ago, ten and twelve feet high, and I expect they will live. I have planted the Norway maple, carting the trees a dozen or twenty miles, that were eighteen inches in circumference and twenty feet high. I have transplanted basswood, English linden and white-ash trees that were five, six and seven inches in diameter, and I expect they are going to live. I have guaranteed to make them live, or I have got to take them up.

Col. Wilson. With regard to the holly, I will say that I have always desired to have a holly in my garden, and last spring I ordered a fine one from Mr. Manning. I prepared a hole three or four feet in diameter, dug it nicely and deeply, gave it good drainage and set out the tree. It shed its leaves, but eventually started out nicely, and to-day it is a handsome tree. If you will take pains, the holly can be transplanted with as much certainty of success as any tree that you set out in your orchard.

I intended to speak of one fact in the line of the statement made in regard to the town of Middleborough. I recall now to mind, the fact that I ascertained by an examination that I made several years ago, that there were at that time about five thousand acres of woodland in the town of Middleborough more than there were fifty years previously, and that may account for all the prosperity they have been having the last few years in this revenue from box-board logs.

Mr. Slade spoke of planting white-birch trees among white pines for the aid that the birches will give the other trees in attaining altitude and thus giving them usefulness and value. Of course the birches themselves have a value for hoop poles, because they are used for hooping merchandise and for various other purposes, and the supply in certain places is not sufficient to meet the demand. The white birch is a tree that is much despised. I remember that my father used to tell me that the blasted things would root out everything else; but at the same time I believe that there are acres of land in this Commonwealth where the white birch is indigenous. It comes up itself, and if our farmers will go about and see that the seed is distributed in the soil, they can, in a very few years, derive considerable income from these trees. That is worth considering. I have seen many pasture lands that were not fit for anything else, and evidently the owner was oblivious to the fact that he might get as much income out of birches planted on that land as out of a cornfield.

The CHAIRMAN. Within the last week, I have seen two or three loads of white-birch sticks carted through this village, I believe towards the lime kilns of Canaan. I thought if there was a market there, there was a prospective bonanza for some of our Berkshire farmers.

Mr. MANNING. There is a very great demand for it.

The CHAIRMAN. I would like to ask Mr. Manning if the holly is a hardy tree in this latitude.

Mr. MANNING. Yes, sir; the tree is hardy enough. The reason you do not see many is because they have been transplanted without reducing the top at all, and the consequence is they generally die. I had, perhaps, a thousand small ones last spring, less than a foot high, that came to me from Philadelphia, and nearly every one lived. They were set out in moist ground and cut back very severely. They were cut back from six to eight feet. My son had seen them in Philadelphia last spring; I had seen them also, and I ordered a thousand of them. They had been transplanted just a year before. If they had never been transplanted, we should have lost them all. A landscape gardener came to me for trees, and after looking around carefully, he said he would not have a tree unless it had been moved within two or three years. He took five hundred and eighty-two trees, from four to eighteen feet high, and reported twenty-six dead ones. Those are my loss. He carted them twenty miles. If they had not been moved frequently, he would not have saved them.

Mr. BUZBY. Do you allow walnuts and acorns to dry after you gather them?

Mr. MANNING. They ought not to dry.

Adjourned to Thursday, at ten o'clock.

THIRD DAY.

The Board met on Thursday at ten o'clock, Mr. WHEELER in the chair.

The CHAIRMAN. I have the pleasure of introducing one of the most experienced poultry raisers in Massachusetts, if not in the whole country, Mr. A. C. Hawkins of Lancaster.

POULTRY AND EGGS.

BY A. C. HAWKINS, OF LANCASTER.

It is with much pleasure that I meet the farmers of Berkshire to discuss a subject that is of great importance to us all; a subject the magnitude of which can hardly be accepted by many of you who have not had experience in it. Although I shall make some remarks in regard to keeping poultry as an entire business, I will call your attention more particularly to the subject of

Poultry and Eggs as Farm Products.

There are many farms in almost any section of the State, the soil and general conditions of which are adapted to the production of poultry and eggs. Carefully managed, this may be a source of much profit to the farmer; and if he or his family have an aptitude for the business, there is no reason why it may not be made very profitable. He will complain from one end of the year to the other that he is selling his milk at a less price than it costs to produce it, that there is no money in raising pork at the price received; he is complaining now that he has raised thousands of cabbages this season that he had to feed to his cattle as there was no market for them, and that what were sold had cost him more than he had realized for them. Let some of these farmers who have suitable land give a part of their attention to raising poultry and eggs for market, care for their fowls as they do their cattle, or as they do for their cornfield when they are trying for that hundred bushels of shelled corn per acre; leave nothing undone that will increase their comfort and consequent thrift, and I am satisfied that the poultry page in their account book will in a short time be looked at with as much pleasure as any other page of the farm accounts. You will always find a ready market for fresh eggs and fat chickens at good prices. There will be no fear of glutting the fresh-egg market, as this country does not produce enough to nearly supply its wants. Millions of dozens of eggs are imported annually to our shores, the American hen being compelled to compete, unprotected by tariff, with the "pauper" hen of Europe, and the "heathen" hen of China. It has been estimated that the cash value of the poultry and eggs consumed in the United States exceeds ($600,000,000) six hundred millions of dollars annually, a greater value than is credited to *any other single product of the country*, whether cotton, corn, wheat or beef. When, therefore, we speak of poultry and eggs we deal with no small matter, but one that is worthy of our best consideration. I have read of certain breeders who claimed that they made a net profit of from $3 to $6 per hen; but I have never classed myself among such clever poultrymen as these, and I have believed that there was a screw loose in their accounts. Possibly they borrowed the grain from their fathers' corn bins, or sold him their eggs at fifty cents per dozen, and chickens at the price of gilt-edged butter per pound.

I do not pretend that I can show the average farmer how he can attain to these extravagant profits, but I propose to explain how every suitably located farm of twenty to one hundred and fifty acres can carry from one hundred to two thousand laying fowls at a net profit of $2 per hen annually, raising enough chickens every year to keep the number of layers full. The first necessity on such a farm will be a suitable building; still, there are many farmers that could fit up sheds, or a dry barn cellar, that they now have, that would answer the purpose for a limited number of fowls. For the benefit of those who have not such buildings at their command, I will explain the erection of a plain, practical building, to accommodate one hundred hens. This building can be built by any farmer who is handy with tools. It should be shed roof, eighty feet long, twelve feet wide, facing south; and if it stands on a south-eastern slope all the better. For a foundation, use chestnut or cedar posts seven inches in diameter, set three feet in the ground, and sawed off six inches above ground; set these posts ten feet apart, both back and front of building. Upon these posts spike the sills of 2 by 6 spruce. Over each post set studs of 2 by 4 spruce, seven feet long in front and four feet long in rear. In centre of each ten-foot section, in front, set two window studs of same dimensions as other front studs. Upon these studs spike the plates of 2 by 4 spruce. Plumb the frame, and board back, front and ends perpendicularly with dry, matched spruce boards. Upon the plates place the rafters of 2 by 6 spruce, two feet apart. Board the roof lengthwise of building with square-edged hemlock boards; eight windows in front, 2½ by 5 feet. The roof and back of building may be covered with the best heavy tarred paper, secured by laths nailed ten inches apart. Cover tarred paper with two coats of coal tar and it will prove water-tight and durable. A ventilator, six inches in diameter, over every second window, will give sufficient ventilation during the very coldest weather. The front and ends should be battened over the cracks and then painted or whitewashed. The inside of building should be partitioned, each twenty feet forming apartments each 20 by 12. Board the partition two feet high at bottom, to keep the male birds from fighting through slats or netting, which may form the rest of the partition excepting the three-foot door in front part of building passing from one apartment to the next. In the rear of building inside, and twenty inches from the ground, make a platform two feet wide running entire length of apartments; eight inches above, and over the centre of this platform, place the roosts of 2 by 3 spruce with top corners rounded. Under the platform place the nest boxes, made as follows: Use a board fourteen inches wide for bottom. Upon the edges of this board nail boards six inches wide, which will form back and front of nests, five inches above bottom board; next put in partitions twelve inches apart, eighteen inches high, making the nests 12 by 14 inches. Nail a five-inch board to the top of partition in front, and to this board hinge the door, eight inches wide, and through which the eggs may be taken from the nests in front, the hens to enter in the rear. Such a nest is appreciated by the fowls, as they may be secluded from the others while laying. It is also easily cleaned and whitewashed. Each nest-box should contain twelve nests, or it may be made in two sections of six each, to secure lightness in moving. The necessary expense for lumber, nails and everything to construct this building will not exceed $70, and you will have a much more practical poultry-house for business than an expensive one with fancy trimmings and lattice-work inside, all of which serve as a harbor for lice. Cover the ground inside four to six inches deep with coarse, sharp sand, which will make a dry, suitable floor, and one that will be enjoyed by the fowls during the cold winter. A thorough coat of whitewash inside will complete the building. The house should be near or in the orchard, that the fowls may have sufficient shade in summer; and if the farmer wishes to enclose them at special times during the year, while he is planting the garden or seeding some plot near by, there should be yards in front of each apartment for this purpose.

The most important of all things regarding the farm poultry is to select a variety of fowls that are hardy, good layers, medium size, quick to mature, and a plump, yellow-legged, yellow-fleshed table fowl. It is also desirable that they be good sitters and mothers, as the hatching should be done in the natural way. A cross made by the Leghorn, either Brown or White, with the Light Brahma makes one of the best families of cross-bred fowls. Also a cross of the Plymouth Rock and Brahma, or Wyandotte and Brahma.

Although a low-grade cow or horse may make a good record, yet, when we look over the list of remarkable horses or cattle, a large proportion of them will be found to be pure-bred animals, raised by men who understood the science of breeding, and who had some great record in view when they caused to be mingled the royal blood that produced the winners. Probably no race of cattle known has made such enormous milk records, or so many of them, as the Holsteins, and we naturally believe that the introduction of such blood in our herds means a great increase in the milk product and in the milk bills for years to come.

When I began breeding fowls, some eight years ago, I was determined to keep only that variety of fowls which combined the most practical merit for a general market, and with this end in view I made many experiments, both with crosses and thoroughbreds. The Light Brahma, Plymouth Rock, Brown and White Leghorn and Houdan were all tried in their purity, and were also crossed with each other to increase the laying qualities of some and the weight of others, keeping nothing further than a first cross. Repeated experiments proved to me that there was no fowl, either half-blood or pure-blood, that combined so many practical qualities as the Plymouth Rock in its purity. The qualities of this variety are too well known to need comment. They have been conceded to be the finest table fowl that enters our markets. Within the last two years they have met their strongest rival in the Wyandotte, which I believe will prove one of the most valuable fowls for the farmer. They are great layers, about the size of the Plymouth Rock, small in bone, but very plump and yellow when dressed. They have clean, yellow legs, which is a very desirable feature in our New England markets. The farmer can make no mistake in selecting either of these varieties in their purity for his regular farm stock. For those who cannot afford to start with a number of these fowls it would be advisable to procure vigorous, thoroughbred males to cross on the best of your common stock.

With the new poultry-house and one hundred vigorous April or early May pullets, twenty-five in each apartment, you are ready to begin business. From careful analysis of the various kinds of food, we find that the constituents of the egg are found in good wholesome proportions in milk, corn, oats, wheat, meat, lime, grass and potatoes; articles available on any farm. In the morning at daylight, give the fowls a feed of warm, soft mash, mixed as follows: one-third in bulk of corn and oats ground together in equal parts, one-third wheat middlings, one-sixth ground beef scraps or boiled meat, and one-sixth boiled potatoes. If this morning meal can be mixed with skimmed milk it will be still better and will induce the hens to lay earlier and oftener. Next fill a tight flour barrel with fresh, clover rowen that has been run through a hay-cutter, and pour upon it four pails of boiling water. Cover the barrel tightly and let it stand till one o'clock, when the fowls may be given all they will eat, which will be considerable after they are used to it. At the same time give them a light feed of wheat and cracked corn, which should be strewn among leaves or some kind of litter that the fowls may get plenty of exercise in scratching for their food. It is very important that they should indulge in this afternoon exercise during the cold weather, as it is conducive to their health and productiveness. Just before dark, feed all the whole corn the fowls will eat, that they may go to roost with well-filled crops of such food as will digest slowly and last them well into the long winter nights. The fowls should have constantly before them clean, fresh water or milk, ground oyster-shells, and green food, such as cabbages or raw turnips. With the above bill of fare and regularly cleaned and ventilated quarters, the farmer will be rewarded with a full egg-basket every night during the winter.

When the warm weather comes and the fowls are naturally more vigorous, they will need feeding only twice daily, morning and afternoon, and if they are allowed the range of the farm, will need no supply of green food or vegetables; but if at any time they are confined in yards or buildings, these articles should figure in their regular diet.

It is believed by many that if fowls are confined in yards and supplied with green food, that their eggs will hatch as well as when running at large; but after repeated experiments on this point, I find that eggs hatch much better and that the chickens are much stronger when the breeding-stock is allowed unlimited range. When the fowls are given this privilege, the egg is constructed of such material as nature intended it should be, and the nearer to nature we can give our stock at this very important time the stronger and more natural will be the germ in the egg. It is necessary, in order that we may be successful in any business, that we should start right and lay a proper foundation to build upon. If the fowl is deprived of nature's food at the time of breeding, the constituents of the egg will be different from what they should be as food to nourish the embryo chick in the shell. If the chick has been nourished by imperfect food during this early stage of its existence, it starts in outside life in a weakened condition. The chick may have the appearance of being healthy, but if nature's organs are not perfectly constructed they may fail to perform the functions necessary for life, and the chick droops and dies. It is then of vital importance to successful production of chickens, that the breeding-stock should run at large at the time that the eggs are forming and being deposited that we wish to use for hatching. With this, then, in view, you should place all such stock in the two outside apartments of the fowl-house about March 1st, in most localities in New England, allowing twelve hens to each vigorous cock to insure the fertility of the eggs.

If the fowls have been laying abundantly during the winter, many of them will become broody by this time, and all that desire to sit should be placed in the two middle apartments of the fowl-house. About March 10, place thirteen good-sized, well-shaped eggs under each sitter. If both apartments are full there will be twenty-four hens covering the nests, with three hundred and twelve eggs. Care should be taken that the nests are so constructed that the hens can cover them easily, for if the nests are poorly made some of the eggs may become chilled and spoiled. There is no better material than fine, uncut hay for making nests for sitters. At time of sitting sprinkle both nest and hen with fine tobacco dust and carbolic acid, either of which will insure the coming chicks from lice, although a second application three or four days before hatching would be advisable. If the eggs were fresh at time of setting, as they should be, most of the chicks will appear on the twentieth day of incubation; but if several days old when set, the chicks will be a day or two later. Allow both hen and brood to remain in the nest for twenty-four hours after hatching, and they will need no food during that time. The hen and chicks may then be removed to a dry coop, two by three feet on the bottom and having a movable board floor covered with fine hay chaff. The coops should be placed not less than twelve feet apart in some sheltered southern exposure, where the chicks may be allowed to run about and bask in the sun. The hen should be confined to the coop for four days, after which she should be allowed to run at large each fair day after the grass has become dry. The first food for the young broods should be stale bread or crackers soaked in milk, and fed in rather a moist condition. With this food they will need no drink till two or three weeks old, when they may have a constant supply of milk or water, which should be always clean. During the first two weeks the chicks should be fed at intervals of two hours, and from two to six weeks old, five times daily; the first feed always at daybreak, or the first thing in the morning. After they are two weeks old, they may be given a feed of wheat or cracked corn twice daily, but always soft food in the morning. When four weeks old, the soft food may be prepared in same manner as described for laying hens, mixing with milk when it can be spared for them; where skim-milk or buttermilk can be procured at from four to six cents per can, it is a cheap food for chickens, as it will place them in the market two weeks earlier and in good condition.

If it is desirable to raise more chicks than the first hatch has brought forth, the nests may be filled again, and the second broods will be off before May 1st. It is not desirable to hatch chickens for market later than June 1st, as the late broods are not liable to do as well when early ones are about, as the older chicks are stronger and will trample over the later ones to their injury. The chicks of different ages should be kept at quite a distance from each other for this reason, allowing only flocks of same age to feed together. When the chicks are six weeks old they may be removed to some other part of the farm, where they will have a fresh hunting-ground for insects, which will form an important part of their food. They should be placed in small, portable houses, eight feet long, four feet wide, three feet high in front and two feet high in rear, with tight floor and roof. The sides of this building should be boarded perpendicularly, leaving one inch space between each board to secure perfect ventilation without a draught. There should be two roosts, running lengthwise of house, made of 2 by 3 spruce joists.

It is an invariable rule that chickens mature much better, grow larger and faster, and are always healthy, when they are allowed to roost in the trees, as nature intended them to do; but their enemies are so plenty in this section of the country it is impracticable to allow them to roost outside, as when we are ready to send them to market the number will be few. A house such as I have described supplies all the favorable conditions of out-of-door roosts, and protects the fowls from all their enemies. Such a building will accommodate forty chickens till the cockerels are ready for market, and will protect the pullets that remain till they are ready to lay. I have proved by actual experiments that chickens six months old will weigh two pounds more, each, when raised in such houses, than those of same age kept in tightly boarded houses with ventilators, etc., both having same feed.

When the chickens are removed to these houses they should be placed at quite a distance from and out of sight of their former habitation; if this is not done, they are liable to go back to their former coops. They should be moved at night, and shut in the house for a day or two, when they may be let out just at dusk, always feeding them near their new quarters. After a day or two they will be contented, and will always be found at night in their new home. If they are placed near some cornfield they will do no injury to the growing crop, and it will serve as a shelter for them from the burning sun. As the season grows later and the hay crop is gathered, these colonies may be scattered all over the mowing fields to a great advantage to the next season's crop. The chickens will destroy all the insects, and the fertilizer that they deposit will make fields look green.

Farmers, one thousand chickens ranging over your mowing fields from July to November, would be worth more to you than the application of two hundred dollars' worth of commercial fertilizer, and you will be receiving a profit on your chickens besides. I know of a mowing lot that has not been ploughed for fifteen years, but has had large numbers of chickens ranging over it after the hay crops were harvested, and the grass was so heavy on it this season that much of it became lodged before it was ready to cut, and on some parts of it there was harvested three tons of hay to the acre. When the chickens were first allowed to run over this piece of land the owner had to take a rake to get enough grass together to wipe his scythe. It was a poor, run-out piece of land that had been neglected and cropped for years without fertilization. Other pieces of land on the same farm, that have been cultivated and manured within two or three years, produced hardly enough grass to sustain the grasshoppers that had flocked to them as a feeding ground.

If the first flock of chicks have had abundance of nutritious food, the young cocks are ready for broilers by June 10, when they will dress five pounds to the pair, and, at the usual market price at that season, will sell at 40 cents per pound, or $1 each. The cost of feeding them to this age has not exceeded 25 cents each, which leaves a net profit of 75 cents for every chicken. The later broods will not sell as favorably, but will bring 25 to 35 cents per pound, until at Thanksgiving they will sell at 20 cents per pound. Still at this latter price there is profit in raising them, as they can be raised to six months old for 6 cents per pound, live weight.

The pullets hatched April 1 will begin to show their red combs and start laying about the 1st of October, while the old hens have taken in their signs till after the holidays. The pullets must be taken to their winter quarters before the cold winds of November come on, as they will lay earlier and better for it. The old hens should be killed off, or there must be new quarters prepared for the young pullets. Hens may be kept through two winters with profit, though we must rely on those April pullets for eggs to make the Thanksgiving puddings and pies.

Don't crowd over thirty hens or pullets into each of the apartments in the henhouse, as you will receive more eggs from twenty-five to thirty than from forty to fifty in the same room. Remember this. It is one of the important points in keeping fowls for a profit. It has caused more disastrous failures and has discouraged more poultrymen than any other one thing, excepting *incubators*. Many people have an idea that one hundred hens will give four times as much profit as twenty-five. Well they will, but they must be kept under as favorable conditions. They must have four times the room, be kept in four flocks, given four times the care and food, and then they will pay you in the same proportion as the smaller number. If you desire to keep more fowls, you must extend your accommodations for them, never allowing less than eight square feet of inside room for each fowl. There is no reason why you cannot keep a thousand as well as a hundred, only do not start with the thousand till you know how to care for the hundred. I have no doubt that you could give the poultry the entire farm to run over, and put your attention to them so that they would yield you more clean profit than any other farm stock.

Some will say that everybody is going into raising poultry, but don't be afraid of that. There is always plenty of room at the top for all of us that can get there.

What you should strive to do is to raise a better quality of goods than your competitors, and then you will have none. If you can furnish a hotel with fifty or a hundred dozen of eggs per week of uniform color, of good size and clean, warranting every one laid within two days of shipment, you will find no lack of customers for your products, at fancy prices. Even if you depend on your grocer for a market for your eggs, it will pay you to have them uniform in color and size and clean; then, when the times of plenty come, he will take your product in preference to some other farmer's, who believes that an egg is an egg, whether white or brown, large or small, clean or dirty. Work up a reputation for yourself for always having the best, and your customers will come to you, instead of you seeking a market for your goods. In the town where I live there was a grocer who had the name of being a little sharp; one day an old Shaker drove up in front of his door and went in and asked the grocer what he was paying for eggs. The grocer replied, "Twenty cents a dozen." "Well," said the Shaker, "can't you allow a little more for some that are extra large?" "Oh, no," said the grocer, "an egg is an egg with me; I make no difference in price." At this the Shaker went out and brought in about twenty dozen of the very smallest pullet's eggs, such as most of us would be ashamed to sell at all. The grocer emptied the basket without comments, and learned that there was some difference even in the quality of eggs.

There is another crop on the farm that is much benefited by keeping large numbers of fowls, and that is the fruit crop. The fowls are very valuable in destroying the borers and other insects that are injurious to fruit trees of all kinds, and a very vigorous and healthy growth of the trees will be noticed around a farm where poultry is kept. The manure seems especially adapted to them, and the fruit will be more plenty, and of better quality. Fowls are more valuable in connection with the cultivation of plums, as there are very few localities where this fruit can be raised, on account of the destruction of the fruit by the curculio. I have now on my place nearly one thousand plum trees, and nearly all trees that are over three years old bear heavy crops every year. A small part of the fruit is stung by the curculio, and drops off, but we have to pick many more to prevent the trees from breaking and to insure a good quality of fruit. Other farms in the same locality, where plum trees are not so favorably located, very rarely get a full crop of plums. Fowls are also valuable in keeping the borers out of the quince bush. It is only necessary to loosen the soil about the bushes, as the fowls will do the rest.

An important item in the keeping of poultry is the large quantities of valuable manure produced. The best method of retaining the ammonia in this manure, which is held in quite large proportions, is to spread dry loam or plaster under the roosts, and then store the mixture in barrels. It will hold its strength in this form, and will prove one of the most valuable fertilizers for corn, grass or grain. It is very strong, and must be composted thoroughly before using it in contact with seed; but if properly applied, it will act quickly on the crop, as its elements of plant food are of such a nature as to be easily assimilated by the plant.

Now a word in regard to the use of artificial incubators by the farmer. Some of you, perhaps, may have used them, and, as you think, successfully. I have tried them for several years, having used all the best machines, and I would not take the best one that is manufactured to-day as a present, if I was obliged to use it myself. Chickens hatched by the hen are much stronger, larger and finer in plumage; there is as much difference between artificially produced chickens and natural ones as there is between Jersey butter and oleomargarine. Nature does her work perfectly when she has proper opportunity. Many will ask how they are going to hatch chickens by the thousand? Just as I have told you how to hatch them by hundreds. You must keep more fowls and there will be abundance of sitters at the proper season. I have probably hatched and raised more chickens during the last six years than any other breeder, and the incubator has hindered more than it has aided me. I have had hatched on my place, in one week, over 1,500 chickens, all with hens. That is fast enough. I have probably spent more than $2,000 trying to convince myself that artificial chicken production was a benefit to me, but after the long struggle I haven't an incubator on my place; still the chickens hatch and grow.

Farmers, if you do not care to put a part of your attention to the poultry, give the boys a start. Buy them good stock and let them study the science of breeding. It will be a benefit to them later in life in breeding larger stock. Let them be doing some business of their own. Build comfortable houses for their fowls and encourage them in their work. They will see the reward forthcoming and will take an interest in the business. Give them the use of a corner of the farm, or let them use the most of it at certain seasons of the year. It will be an advantage to your crops and they will show you that the poultry is the paying crop of the farm. When drouth and frosts ruin the field crops the poultry will be left to pay the bills.

The farm that I now occupy did not produce crops that would sell for $100 in 1875, and in 1884 the sales from the same farm will exceed ten thousand dollars; and if things go onward as in the past, if the fruit trees that are now young produce such crops as those that are old enough to bear, the products will sell for $25,000 in 1890.

The CHAIRMAN. Gentlemen, you have listened to one of the most interesting papers of this meeting, and now there is an opportunity to discuss the question which has been treated in such an instructive and interesting manner by Mr. Hawkins. If there are any in the audience who have any questions to ask, Mr. Hawkins no doubt is as well prepared to answer them as any one.

Question. I did not quite understand what you used for your mash for the fowl?

Mr. Hawkins. One-third provender, corn and oats ground together, in equal parts in bulk, one-third middlings, one-sixth meat, and one-sixth cooked vegetables.

Mr. Grinnell. You did not speak of the Game nor the Dorking.

Mr. Hawkins. No, sir.

Mr. Grinnell. I think that a Game cock and a Brahma hen make an exceedingly good cross.

Mr. Hawkins. I think they would. There are something of the same nature as the Leghorn and Brahma.

Mr. Grinnell. You confine yourself to Plymouth Rocks.

Mr. Hawkins. I have the Wyandotte and Plymouth Rock.

Question. What is the origin of the Wyandotte?

Mr. Hawkins. The Wyandotte is produced by crossing the Dark Brahma with the Silver-spangled Hamburg. They are a fowl of medium size.

Mr. Munson. I did not understand what the speaker said of the Hamburgs.

Mr. Hawkins. I said nothing good of them. I don't think I mentioned them excepting just now. I was asked to state the origin of the Wyandotte, and I said they were the result of a cross of the Silver-spangled Hamburg and Dark Brahma.

Mr. Grinnell. You get black legs, don't you?

Mr. Hawkins. No, sir, orange yellow; the best colored legs of any fowl I ever bred.

Question. What is the cause of gapes in chickens, and what is the remedy?

Mr. Hawkins. It is caused by worms in the windpipe, and those result mostly from filth around the buildings. The best way to prevent the trouble is to have nothing of that kind about; but if fowls are attacked with it, they can be confined in a barrel, lime put in the barrel, and they will breathe the fumes, which will cause them to choke and throw the worms out of the windpipe. That is the best remedy I am aware of, although I never had any trouble from the disease.

Mr. ———. I am very glad to have this poultry question brought up for discussion. I have looked into this matter for a year or two, and have come to the conclusion that it is one of the most neglected branches of industry on the farm. The paper which has been read, I hope will set us thinking and investigating. It costs us to produce beef and pork, six, seven or eight cents a pound, and that is all we can get for it. To produce poultry per hundred pounds or per pound costs no more, I believe, than it does to produce pork; and it will produce, live weight, more than double what pork will produce, dressed weight.

I heartily agree with the speaker when he says, "Encourage the boys; give them something to keep them at home; give them something to interest them in the farm." Two years ago I visited the hennery of our lecturer, and bought a trio of fowls for my boys; I made them a Christmas present of them. They were shut up, and an exact account kept of everything that was fed to those fowls. Some of the chickens were sold for broilers, some were sold for breeding purposes, some of the eggs were sold in the market and some were sold for setting. At the end of the year, the result proved that from those three pullets and a cock $56 and some cents had been realized, which, with the balance on hand, made up $66 and some cents. Now they are working out the problem this year: If $14 can be produced from one fowl, how much can be produced from fifty? What the result will be I do not know; but I would urge upon farmers that they give their boys something to interest them. Make your boy a present of some poultry, let him manage them himself and have the proceeds, and he will take a great deal more interest in the farm, and not be so apt to want to leave it the first opportunity.

Mr. Ballard. I have not heard any one bring out one point so fully as the lecturer has, and that is, in regard to milk for feeding fowls. I have followed the practice for the last ten or fifteen years. About seven years ago I was feeding my pigs milk; the price of pork was pretty low, and I said, "After this I will feed all my milk to my fowls." I have made up my mind that I can make more on one dollar with fowls, by feeding my milk to them, than I can on four dollars with swine. I keep from eight to ten cows, and the fowls and chickens take all the milk. It answers for grain and meat and all things combined. I believe it is the testimony of chemists that milk contains more of the constituents of the egg than any other food.

QUESTION. I would like to ask the speaker to what time of the year his remarks with regard to the food given in the morning apply; whether the year round or only in the winter?

Mr. HAWKINS. That was only for winter food. I mentioned that that was cold-weather feeding. When the season grows warmer take a different food.

Mr. BALLARD. I let my fowls run at large.

Mr. HAWKINS. It makes a great deal of difference whether they are at large or confined. I mentioned that they would not need some of those articles when they were allowed to run at large.

Mr. BALLARD. Have you ever used soap-chandler's scraps?

Mr. HAWKINS. I have used them, but I have meat that I like better for the purpose. It is selected from the markets in the city every day, and boiled for the tallow, and the meat that boils from the bones I have saved for me. It comes in a cooked form, ready to feed. It will not keep long in warm weather, but I feed so much of it that I get it fresh every day.

Mr. BALLARD. I tried some of the animal meal. I don't know what it is. It is like a good many other things that we buy, that we don't know much about. Finally I went down to the soap-chandler's and bought five hundred pounds of scraps, and I have followed it up every winter. I put it where my fowls can go and eat it whenever they wish, and I have had very good success with them in the winter.

QUESTION. How do you keep eggs from freezing in winter?

Mr. HAWKINS. If the house is constructed as I advise it should be, the eggs will not freeze during the day in the building. I do not want to leave them in the nests more than one day. In cold weather the eggs should be collected every night, and there will be no trouble from freezing.

Question. Will you state how you cover your house?

Mr. Hawkins. It is covered with tarred paper on the back and sides, and the front is battened, so that the eggs will not freeze.

Mr. Beebe. I have about eighty hens that I have bred from the old dunghill stock, without any crossing whatever, for twenty-seven years. They are good layers, they come to maturity quicker and are a great deal handsomer than the fancy breeds. I have plum trees about my henneries. My hens have the free run of a thousand acres, and there are no fowls nearer my flock than a mile, so I don't think they have been crossed. My plum trees bear fine fruit.

Question. How do you break up sitters?

Mr. Hawkins. I have a room in the centre of each of my long buildings with no nests, and when a hen wants to sit she is carried to this room, and in four or five days she has got over her disposition and will go to laying again.

Question. Do you leave those hens alone or put cocks with them?

Mr. Hawkins. I advise having a cock in the room with them.

The Chairman. I see in the audience this morning a distinguished agriculturist, — one who has imparted information of the greatest value to the agricultural community, — formerly from Massachusetts, now the distinguished Director of the New York Experiment Station, Dr. Sturtevant. I shall be very glad to introduce him to this audience.

Dr. E. T. Sturtevant. Mr. Chairman and gentlemen, — I did not come here prepared to speak, but there are a great many subjects I can talk about. A person who has many assistants under him, furnishing him facts all the time, necessarily becomes acquainted with a very large field in agriculture. If the audience will indicate some subject they would like to have me talk about, if I know anything about it I will talk about it; if not, I will ask for another.

The Chairman. Dr. Sturtevant has given great attention to the raising of corn, and I will ask him to state the effect of selecting the earliest ripened ears.

Dr. Sturtevant. I come with the greatest modesty to talk upon this question. You will find an essay of mine in the "Agriculture of Massachusetts" upon corn. Now, whether I contradict myself or not I do not care, because it is the part of science to follow facts, to follow truth, to speak your best knowledge of to-day without regard to any knowledge that you may have put upon record yesterday. I may say that corn has occupied a good deal of my attention. I have given it most careful study now for a long period of time. I have, as yet, attained to scarcely any real knowledge upon it; but I have found about corn some facts which, I think, can be accepted, and which will stand the test of time. Some of these facts, if I had been told them a year or two years ago, I should have declared manifestly impossible, and should have looked upon them as the utterances of a monomaniac rather than of one who had knowledge. So, if I speak upon this matter a little differently from what may seem to be your experience, I hope you will have a little patience with me.

I shall have to approach this question in a somewhat roundabout way. One of the things which you may consider as proven about corn is, that each variety has certain habits which apply to that variety and do not apply to others. For instance, if we plant Adams's Early Dent corn, and if we plant Chester County Mammoth corn, as illustrations, we have in one case the early-ripening Dent, a small plant, usually not more than from two and a half to three and a half feet tall, which bears ears near the ground and ripens the latter part of August, but will be fit for table use in the early part of August; while in the case of the Chester County Mammoth we have a tall-growing corn which ripens its ears not very early, — indeed, too late for the average season in New England, — but which will succeed in the climate of Pennsylvania, and in some few selected localities further north, and bears its ears high up from the ground. Here, you see, there are differences which are transmitted from the seed to the plant. If you examine still further you will find that the crop of those two varieties will always differ; that there are certain maximum crops which can always be obtained from each, but there may be a difference of thirty or forty weighed bushels per acre between the two crops. In other words, in order to have a maximum crop of corn, we must have seed which is capable of yielding that crop under the usual treatment. If we take a seed which is not capable of yielding the maximum crop, then all the culture we may give that crop will not bring it up to the maximum crop of the better seed. There is the first point that I want to make.

The second point which I will make is this, that it is almost impossible to tell what is the best seed-corn, because, unfortunately, the nomenclature of seed-corn is so confused that if I said a certain variety was good, I should not be surprised to have several people step up and say that that variety is poor. I will mention a case in point. Most of you are acquainted with Mr. Cheever, the agricultural editor of the "New England Farmer," a man whose powers of observation cannot be questioned, neither can his honesty of purpose. We were conversing some time ago upon a variety of corn, and we found that our experience was directly contrary. I told him that the Leaming corn was unworthy of any attention in the latitude in which we live, as being a late corn, belonging to a more southern locality, and which would not ripen its crop in this section. On the other hand, he told me that the Leaming was one of the earliest and best of the Dent corns; that he had grown it in Eastern Massachusetts, and that it ripened at about the same time with the Waushakum. Now, Mr. Cheever was undoubtedly right, and I have no question that I was right; but, when we come to look into the probabilities, the probability is that we were growing two different kinds of corn under the same name, and he reported the facts concerning the variety he grew under the name of the Leaming, while I reported my experience with a variety that I grew under the name of the Leaming. In order to test this question, I have lately been selecting the seed-corns named in our seed catalogues, — over one hundred in number, — and identifying them. I once sent to nine of the leading seedsmen in this country for samples of King Philip corn, which is one of the best known and most easily recognized of all our varieties of corn. It has the color, the shape of ear and habit of growth which make it a very distinct variety. What was my surprise on finding that I got seven different kinds of corn sent to me by nine different seedsmen under the name of King Philip corn! With this explanation, you will see the difficulty of recommending any seed-corn. When you buy that seed-corn, the probability is you will not get, under the same name, the kind which I recommend under that name. So that one of the most important things in agricultural experiments is in describing and localizing the varieties of our farm seeds, in order to know whether we buy what we think we have bought, and in order that seedsmen can all supply the same articles under the same name.

Now, you will see the bearing of these remarks upon the question which ears shall be selected for seed. If you select the earliest ripening ears from one variety of corn you may make a gain and you may not. It is just about an equal chance whether you will gain or lose, because the question is complicated by the question of what variety you select the ears from, and by the conditions under which it is grown.

Now, I am coming to a discovery. The corn plant is a very curious plant. It has certain agricultural species, — I don't mean botanical species, — which can be described and distinguished, which we recognize as the Dents, the Flints, sweets, softs, and the pops. Any farmer can tell the difference between those. Now, when you bring these varieties together, you will find that they do not equally cross-fertilize with each, other as the public have always imagined they did. That is, it is very difficult to cross the Flint and the Dent. If you undertake to cross the Flint with sweet corn, you will find that the sweet corn will receive the pollen of the Flint corn and show Flint kernels growing upon the ear, but in no attempt which we have yet made have we succeeded in growing sweet corn upon the Flint corn; the interchange is all one way. I have grown a thoroughbred seed-corn for three years in succession, alongside of one hundred and thirty-five varieties this year and a hundred and twenty varieties last year, and I have not as yet been able to find one single clear instance of cross-fertilization on this seed-corn from these many varieties surrounding it. In order to show you the carefulness of my experiment, I will say that I handled many hundreds of ears, and examined each ear by itself, in order to justify this statement, which is so contrary to all my previous ideas and to the ideas which are current.

Now, if you will buy some seed-corn, under any name you please, whether Early Canada, King Philip, or any of the names you are familiar with, and plant it, and then examine the crop, you will find one peculiarity. You will find that, as a rule, you will have several different varieties. For instance, you will find in the Early Canada that a portion of the crop will be of the New England eight-rowed type, while another portion will be of the Canada type. If you will plant a Flint corn which has been grown in the vicinity of a Dent corn, you will find many Dent ears in the crop. This was a suggestion for experiment to see what would take place. By carefully crossing the Flint and the Dent together, — forcing a cross, so to speak, — you will find no effect from the pollen of the first year, but that the cross-seed will give you plants some of which will bear a Flint corn and some others a Dent corn; but both varieties will give precisely the same variety with which they were crossed. For instance, if you take the Waushakum and cross it with the Minnesota Dent (or North Star, which is the preferable name), that cross-seed will give you precisely and exactly the Waushakum Flint and the North Star Dent; there will be no mixture in the ears. Under these circumstances of careful study, it is very rare to find what may be called "a sport" in crossing. So that if you take any ordinary seed-corn, and try to make a selection, you cannot tell whether you are selecting from one variety or another, because most of our crops are mixed varieties, eight and twelve-rowed all mixed together, and whether you take one or the other in the selection will make a difference in the result. So that when you select seed-corn, the first requisite is to act on this idea of securing uniform seed. Then it is more than probable that you may succeed in earlying that corn by selecting the earliest ears. I hesitate to give you results which are yet incomplete; yet, in trying experiments with many different species of plants, the results have been corroborated in some cases for two years, but in most cases only one.

But we have a better clew for a method of securing early crops than the one which is suggested by the experiments. If you will take common green pease, which you are ready to gather for your table, and plant them, those pease will grow, and those plants will probably give you, on the average, earlier pease than will the ripe seed from those same plants. If you will take the seed of a green tomato, — a tomato half grown, — and take the seed of a tomato which has ripened upon the same plant, you may find, as we have this year, a difference of fifteen or more days in earliness between the plants grown from the green seed and those grown from the ripe seed. If you will take the green seed of beets, — the unripe seed, — and plant those, you will find, perhaps, a gain of from six to eight days of earliness between the product of the unripe seed and the ripe seed. If you will take thoroughbred corn, of a known constant character, and take a boiling ear of this corn, or one a little too green for the table, and plant the seeds, some will grow ; and those seeds, for two years running, have given us earlier corn than the same seed picked ripe. We have gone through a dozen different vegetables and the experiments all tend one way. They show that by using unripe seed we can get increased earliness in our plants.

But you must remember that these green seeds will give you feebler plants. If the idea is a true one that you can attain earliness in this way, it may be necessary to use ripe seed from the plants grown from the unripe seed, in order to get back again the vigor of the plant, which is of very great importance in our horticulture. There is simply one idea thrown out on this point in regard to earliness.

Now, there is another idea in regard to corn which is still better than the one suggested in the experiments. If you will go through a hundred varieties of corn planted together, you will find that the distance of the ear from the ground is in almost constant relation to the earliness of the crop. It seems always so when you use pure seed. There is a sort of catch-all or waste basket among seedsmen which catches every variety of sweet corn which is not named, and it is sold under the name of eight-rowed sweet. When a seedsman wants to get a new variety, he can go to that waste basket, pick out an ear and put it on the market as a new variety of eight-rowed corn, and thus give his place a reputation as a place where you can always go and get something new. But seedsmen do the very best they know how to do. They keep right up in advance, and any slander upon seedsmen receives no endorsement at the experiment station. We have had over a thousand varieties of different vegetables growing each year. They are carefully examined, and, as a rule, we believe that the garden seeds we buy are pure; and if they are not pure, it is simply on account of the ignorance of the seedsmen, in which we share, and not from any intent to defraud the public. The germinating quality and uniform character of the seeds obtained from our leading dealers are perfectly surprising. They are deserving of praise. This idea of taking the results of foreign investigations and applying them to our seedsmen is ungenerous and uncalled for, because we have no facts recorded in this country which afford any justification for that course.

Now, this early eight-rowed sweet corn, bought of one of the leading seedsmen last year, when we came to harvest, October 16th, gave us ears thoroughly ripe; other ears which were just in the condition we ordinarily gather sweet corn for seed, not dry, but sticky; and other ears just in condition for the table, and still other ears which were not yet fit for the table. Here we had all these different varieties of earliness within the same seed, very likely coming from kernels taken from the same ear. Whether you take the seed from one ear or a dozen ears, it will probably make no difference in that respect. Now, if you will look into this subject, you will find that all these very early eight-rowed corns have ears eighteen or twenty inches from the ground, while the later kinds have ears thirty inches or more from the ground. If you will take the earliest known variety of corn you will find the ears coming out at the surface of the ground; and if you will take the latest variety, you will find the ear clear up on the stalk. Take some of the South American corns, and you have got to almost use a step-ladder to reach the ears. Now, if you want early seed-corn, you can pick out those plants which bear ears near the ground; and in doing that you will work upon a definite plan, which, if wisely followed out, will bring about the result desired.

The Chairman. Dr. Sturtevant, as I told you in introducing him, is the director of the New York Experiment Station; and, as you all know, we have an experiment station here in Massachusetts. You probably do not know much about what that station is doing, although they issue, at frequent intervals, bulletins of their work, which are published in our weekly press. Now, I would like to have Dr. Sturtevant say a few words, if he will, in regard to the value of the work of an experiment station, and what results and benefits you may expect to derive from it if you give it the support which it deserves.

Dr. STURTEVANT. I want to make a few remarks upon the subject of experiment stations, on account of the importance of them to agriculture, and I hope you will not consider me as in any way boasting if I simply give you a few facts concerning the New York Experiment Station.

The farmers of the State of New York have had the good fortune to have enough money appropriated by the legislature to justify the establishment of an experiment station. We have a plant which cost $25,000 to begin with, and we have now an appropriation of $20,000 a year for its maintenance. We have a board of control who have had the wisdom not to hurry in the least; but who frankly say, "We are willing to wait for results." Therefore, for the first time in the history of agriculture, in this country at least, we have had a station with sufficient funds for its maintenance, and we have had no untoward public pressure requiring us to do work simply for show; so that we can go about our work quietly, and wait until we can develop some facts of interest and then bring them before the public. That is a very important thing.

Now, one of the greatest drawbacks to an experiment station is this: — Agriculturists, and the people at large, complain of the methods of research adopted, and the expense of those methods and the object of them. There are a great many fallacies in agriculture which we have not yet found out, and it only requires a man to put his predictions to the test by the scale, by the measure, by counting, by the mathematical test, to see how ignorant he is upon many things with which he thinks he is fully acquainted. I suppose there are a great many farmers who are willing to say whether a fertilizer has been a benefit to one piece of their land and not to another. I do not expect to be believed, and yet I doubt if there is any man in this room — if so, he is an exception — who can tell a difference of twenty bushels of corn to the acre by the eye, between two adjoining plats, side by side. I doubt if there are many farmers who can grow two pieces of corn and say which one yields the most at harvest, — even if he measures it, — because one variety of corn will measure more and weigh more than another on account of the water in the crop, and the farmer does not wait until it gets dry and then weigh and measure it to see which one comes out the best. Now, it is this accurate, careful work which we have to do. Part of our work is to overturn popular ideas. Before we can make progress in experiments, we have got to show the public the fallacy of various ideas that have been in vogue, some of them for a long period of time.

Now I will pass on (because I do not want to take much of your time) to the idea which is so popular and so thoroughly believed in, that all you have got to do, to test the value of any two fertilizers, is to take two pieces of land, of presumed equal fertility, and treat them in the same way, measure the resultant crops from the two pieces, and interpret the effect of the process upon those crops. The idea is that such an experiment is not costly, and can be done simply and easily; that any one can do it without giving to it hard work and hard study. That is a great error. In 1882 I thought I knew all about this matter, but when I went to my new field I found I was not right in my judgment. I have not yet got to a point where I can say I know how to test the value of two different kinds of fertilizers practically. I do not know how to do it; I have not succeeded in doing it, and yet you will find that it has been claimed to be done time and again. The fallacy consists in assuming that two fields are of equal fertility, whether we know they are or not. Here are two adjoining plats of land which have been treated from unknown time as one field. There is no difference perceptible in the grass growing upon that land, and we have no reason to know that one plat is better than the other. How can we tell whether one is superior to the other or not? The natural assumption is, that if they bear equal crops, they are of equal fertility. I think we all agree as to that; I did agree to it until I found to the contrary. [Here the speaker made a diagram upon the blackboard.]

D 18.

1883. 400 lbs. phos. per acre.

EARLY AMBER CORN.

1,131 lbs. forage.

1884. 400 lbs. phos. per acre.

WHITE STAR POTATOES.

Single eyes — 573 hills.

Yield.

	lbs.	*oz.*
Merchantable, ...	546	8
Unmerchantable, . . .	23	12
Total, ...	570	4

E 17.

1883. 400 lbs. phos. per acre.

EARLY AMBER CORN.

1,133 lbs. forage.

1884. 400 lbs. phos. per acre.

WHITE STAR POTATOES.

Single eyes — 434 hills.

Yield.

	lbs.	*oz.*
Merchantable, ...	294	4
Unmerchantable, . . .	38	8
Total, ...	332	12

1882. Sod.

1883. 400 lbs. phos. per acre.

Yield 235¾ lbs. ear corn.

1884. 400 lbs. phos. per acre.

WHITE STAR POTATOES.

¼ potatoes for seed — 590 hills.

Yield.

	lbs.	*oz.*
Merchantable, . . .	678	5½
Unmerchantable . . .	50	0¼
Total, ...	728	5¾

1882. Sod.

1883. 400 lbs. phos. per acre.

Yield, 233¾ lbs. ear corn.

1884. 400 lbs. phos. per acre.

WHITE STAR POTATOES.

¼ potatoes for seed — 591 hills.

Yield.

	lbs.	*oz.*
Merchantable, ...	784	12½
Unmerchantable, . . .	42	3
Total, ...	826	15½

In 1883 these plats were planted with field corn in rows, with four hundred pounds of fertilizers. They were planted the same day, hoed the same day, the fertilizers put on the same day, and the crops harvested the same day and weighed. On the twentieth of an acre, the product was $235\frac{3}{4}$ pounds of ear corn per acre on one, and $233\frac{3}{4}$ pounds of ear corn on the other. You will say at once, those were duplicate plats; and if I put four hundred pounds of fertilizers upon this plat in 1884, and nothing upon that one, and found an increase of twenty, thirty or forty pounds upon the plat where I put the fertilizers, the idea would be that that increase was produced by the fertilizers. But no such thing happened. What I am going to state is not a single instance; I could give a dozen or more of exactly the same purport. We planted potatoes upon these plats in 1884. Those potatoes were planted with single eyes, cut from the same size potatoes, cut into the same basket and planted from the same basket. The pieces were cut as nearly the same size as practicable; as luck would have it, they nearly all grew. We had five hundred and ninety hills on this plat, and five hundred and ninety-one hills on that plat; practically the same,—only one hill difference. Those potatoes were harvested the same day and weighed at the same time, upon the same scales. The crops on the two plats were raised under precisely the same conditions. When we came to the yield, we had seven hundred and twenty-eight pounds from one plat, and eight hundred and twenty-six pounds from the other. In other words, to be exact, we had 32.8 bushels to the acre difference between those two plats. Now, when you find this great difference coming from some unassignable cause, you see how difficult it is to take two plats, and put fertilizers on one and none on the other, and then be able to say that the increase or decrease is due to the absence or presence of the fertilizers. It simply shows the entire fallacy of this whole system of plat experiment; for it is a fallacy, as all our results go to prove. It will be seen that we have got to get at our results in some other way than by this simple method. In order to answer the question as to the increase in the value of crops, we have got to get at our facts in a roundabout way, by mathematics, by working out the problem by the law of correction, by which we can correct our results as an astronomer corrects his results, in order to make them agree and bring them down to the definiteness which is required.

Now, in order to get at these true results, it takes money, takes time, takes skill and talent; and here I am coming to what I want to say to this Massachusetts audience. In order to make any experiment station a success, you want to give the men employed there money enough to enable them to study these things in a thorough way, or you cannot expect to learn much from that station. If you want your Massachusetts Experiment Station to do good work, it must have enough funds given it to remove it from criticism. It is not fair, it is not proper, to criticise the work done at an establishment, where so much is expected from them and where no opportunities are given them for doing any work. An annual appropriation of $20,000 is none too much. There are subjects coming up every little while, which must be investigated, and which may require the expenditure of money. If you are working close to the appropriation, you will not be able to do that work. The station should have a full treasury all the time. My own plan is to keep one or two or three thousand dollars leeway; not to expend the appropriation within two or three thousand dollars, if I can arrange it, so as to have money in the treasury to meet any unexpected demand which may call for additional labor or skill in doing the work. We only spent $17,000 last year of our appropriation of $20,000, and this year we shall spend about $19,000. If we had $17,000 appropriated, I should make my plans to spend but $15,000, so as to have $2,000 leeway. When you give your experiment station the paltry sum of $5,000, it is hardly enough to overcome friction and pay its employees; you have so hampered it that it ought not to be the subject of criticism. You ought either to stop that appropriation and let the station die, or give it something more. There is nothing gained by hampering this work by insufficient means. The only question is, whether it is worth the expense. If you want an engine to move a train of cars, you cannot do it if you have only steam enough in the boiler to overcome friction, and the whole expense up to this point becomes waste. It is the extra amount of steam you put on that gives the speed to the train. It is just so with an experiment station. You may give it just enough to overcome friction, and to do things which the farmer can do himself just as well, and in that case you ought not to expect much of anything from it. You ought to give it enough additional means to make it of benefit to agriculture.

What I have said will show you what can be done by experiment; but we have got to destroy the idea that experimenting is a cheap process, that anybody can do it. I have not learned yet, in three years, with all my facilities, how to experiment.

Mr. Sedgwick. There is one experiment which the New York Experiment Station has undertaken, which has paid the farmers of this country a hundred times more than any appropriation they could have made, and that is, Dr. Sturtevant's potato experiment. I was told by a prominent commission man in New York that the effects of that experiment on the crop of potatoes on Long Island had been not only to increase the crop, but to make the potatoes of larger size than ever had been raised before the experiment was made. There is one simple thing, the knowledge of which has probably been worth to the farmers of this country thousands of dollars.

In your Massachusetts Experiment Station an experiment has been begun by Prof. Goessmann which has already proved to be of thousands of dollars benefit to fruit raisers, and undoubtedly in the future will pay them very heavily. I refer to his experiment in regard to peach yellows and the proper application to prevent it. A prominent nurseryman told me the other day that the application recommended by Prof. Goessmann for the prevention of this disease was worth everything to him. There are two simple facts which show that we cannot appropriate money to better advantage than by the establishment of these experiment stations and sustaining them well.

Mr. Milliken. I want to ask Dr. Sturtevant if he has tried any experiments or can give us any information in regard to the white grub which is committing such depredations on our farm crops, particularly corn, grass and potatoes. The only information I have in relation to it I have obtained from "The New England Homestead," which states that the grub is the larva of the May beetle or the June bug. I want to say that since I have been here attending this meeting I have met a gentleman from the town of Sheffield who tells me that the beetles have done very much damage to his orchard, particularly plums; that they have stripped the foliage from the trees. There are farmers in this county and the adjoining county who have suffered thousands of dollars of damage from these grubs. I want to know how we can successfully combat these enemies of our crops.

Dr. Sturtevant. Did you ever know the grubs to come two years in succession?

Mr. Milliken. I have not been aware of their presence on my farm until this season. I have seen their effects, I think, which I attributed to other causes. I supposed that the sudden decrease in the grass crops from our meadows was caused by the drouths. This summer I was satisfied that we should have a short hay crop and I procured the best sweet corn I could and planted a number of acres. I was surprised to see that when it came up it began to wither and showed all the indications of blight. It did not seem to be the effect of drouth. I began pulling up that corn by the roots, and found in almost every hill that I examined from four to a dozen of these grubs. They went through not only my sweet corn, but my field of common corn of about eight acres, and destroyed almost the whole field. I should have got not less than forty bushels of shelled corn to the acre; I did not get a hundred bushels of ears. When I cut it in September, most of it was not more than two feet from the ground.

Dr. Sturtevant. I know of no way as yet of overcoming the grub by any remedies; but there is this to be said, which gives us encouragement. I asked you the question whether you ever knew the grubs to come two years in succession on the same piece of land. I have asked the same question of a great many and have never heard it answered in the affirmative. When they come in great abundance, I think we may know they will not come again for six or seven years. When they come in small numbers, you may expect them to increase. There is no remedy that I know of that has been applied.

Capt. MOORE. I have seen, ever since I was a boy, the effects of the larva of the May beetle. Harris describes it — and I presume other entomologists have done the same — in this way: That the May beetle deposits its eggs near the surface ground, on the roots of grass and plants; that those eggs in a little while hatch and the insects enter the ground as small grubs; that the first year they eat in a small way, and when winter approaches they go down, usually below frost, where they lie dormant in the soil during the winter. In the spring they come nearer the surface of the ground to get their food. They eat that year; they eat the next year; and if you have been in the habit of carefully watching them, you have found that the third year they are going into the chrysalis state in the ground. I have seen them with the rudiments of wings. During the next year they come out of the ground and fly through your trees. You may see them flying in the early part of the evening, and then they go through that operation again. That is, they remain in the ground two full years and part of another.

Now, how shall we get rid of them? You cannot get rid of them by undertaking to kill them, because there are so many of them. I have seen the sod of a lawn or piece of grass so infested by them that the roots of the grasses were eaten off within about an inch of the surface, so that you could take it and roll it up just as easily as you could a piece of carpet that was not nailed down at the ends. I have found the ground covered with these worms. I have seen a flock of ducks, quite a large number, go on to this ground where it had been ploughed. Those ducks when they started in were standing up on their legs and held their heads up. They would continue to eat (I never saw a duck full yet), and after they had been there for three-quarters of an hour they would begin to squat down, and by and by they would begin to draw their breasts on the ground, and finally they would lie down; but they would still eat the grubs. There is no end to their capacity to eat grubs. I don't think, however, that you could keep ducks enough to destroy the grubs. The only way is to learn something of the habits of the female and how she deposits her eggs.

There is one way in which you can destroy many of the beetles with very little trouble. It will not destroy all of them, because some will go away to your neighbors; but it will prevent a great many from depositing any eggs. That is, by simply going under your trees where they are flying, setting some tubs full of water, and hanging a kerosene lantern or something of that kind over those tubs, a little way from the ground. The beetles butt their heads against these lanterns and fall into the water. I have found a peck of them in the water the next morning. That is the only way I have found to reduce the number of grubs, and I have been a pretty careful observer in that line, I may say, during my life, because they are the fellows that annoy Mr. Slade and myself in our strawberry beds. They do not get through eating a strawberry bed in one year. I have a strawberry bed which has been picked three years; they have eaten more or less in that strawberry bed every year, and they have been doing it this last fall. I cannot hope that I have got rid of them. They have started, and they have got to go through their regular course of transformation, which takes three years. You have probably observed the old, mature worm just ready to go into the chrysalis state. Being small, you do not see the effects of their ravages in your grass land; but when they get into the last years of their growth, then they are enormous feeders and you will notice them quicker.

There is another grub that is very similar to this grub, but does not do any great amount of injury. You will find it in piles of manure. Even manure that has not lain more than three or four months you will find full of a white grub which looks very much like this, but it is not the same grub, and does not eat in the same way.

Mr. Slade. Our greatest trouble in raising strawberries is from the depredations of these worms. You have no way of telling that they are there, until their presence is announced by the wilting of the leaf and the death of the plant. So, if you dig them out, it is like closing the door of the stable after the horse is stolen. About eight years ago, I lost a piece of strawberries by this worm. Since that time I have not been troubled at all, and consequently have grown rather negligent in regard to preventing their depredations, if I could do so. Last spring I set a piece of about two and a half acres of strawberries, and, not anticipating any trouble from these worms, I expected to have a very nice piece of strawberries from the pains I took with them. While I was setting them out a young man who was just going into the business came to see me, and he said, "The piece that I am going to set is full of white worms; what shall I do? There are thousands of them." I said, "You better not set it this year; let it go until next year." Said he, "I can't do that; it is all the land I have." He insisted upon my suggesting some remedy. I did not tell him I hadn't any remedy, but I might have said so and told the truth. I found he was bound to have something, so I said, "Stir up some paris green in water and dip the roots of the plants in it before you set them out, and go ahead." He followed my advice, and has got as handsome a piece of strawberries as you ever saw in your life; not a worm has troubled them.

There is another thing which has been tried with considerable success in setting strawberries; that is, a small spoonful of sulphur dropped where the root is going down. That is said to prevent the ravages of the worm. I merely throw this out as a suggestion.

Gentlemen, I have attended a good many meetings of the State Board of Agriculture, and I think this has been one of the most pleasant and profitable meetings we have ever had. We have all been treated very kindly by the people of Great Barrington, and we shall all go home remembering the kindness with which we have been treated, and the hospitality of the inhabitants; and I hope to live long enough to come here again, not as a member of the Board, but as a spectator. [Applause.]

Secretary RUSSELL. I am reminded by these pleasant remarks of Mr. Slade in regard to the success of our meeting here, that yesterday, at an informal meeting of the Board, the thanks of the Board were voted to the citizens of Great

Barrington and vicinity for their assistance at this meeting and their kind reception of us.

I may say that I regret that, in a farming community like this, instead of a few hundred who have had the benefit of these meetings there have not been thousands; for, as I said to a reporter at the table half an hour ago, the lecture to which we listened this morning, if it had been improved as it should have been by the attention of the people of this vicinity, would have been worth a hundred thousand dollars a year to this region for an indefinite period.

The CHAIRMAN. I think I am authorized to speak for the citizens of Great Barrington and for the district society, and to return our thanks to the Board of Agriculture.

Mr. KLINE. Mr. President and gentlemen of the Board of Agriculture, I wish I had the power of speech that would enable me to excuse our citizens for their neglect to attend these meetings in greater numbers; I have not the power to do that. The facts are before you; but I hope you will be consoled by the belief that the best of our people have been here, and that they have been very much entertained and instructed by the excellent essays and the discussions. I think that those who have been here will put these ideas into practice, and those indifferent ones who have stayed away, will, in time, be educated by your having been here.

As I was riding here yesterday morning by the side of one of my neighbors, one of the best farmers of southern Berkshire, I remarked to him, "There are three classes of farmers. First, farmers who spend a little time in riding around, comparing notes and attending agricultural meetings. I notice that they are the most successful farmers in any community. The second class consists of farmers who stay at home and drudge from morning until night, never go anywhere, and never learn anything but what they can learn at home. They are a hard-working class; they get a living, but do not get far ahead. The third class do not stay at home a great deal, but spend most of their time in the grog-shops and other places. These are the farmers who have dilapidated buildings, never take their families out for any enjoyment, and are going behind the times altogether."

Mr. MUNSON. I would like to inquire if fall ploughing will not run out the larvæ of the May beetle.

Capt. MOORE. I have no doubt that fall ploughing would, to a certain extent, destroy these grubs, if it is done very late in the season; but the habit of the grub is to go somewhat below the frost and prepare for transformation.

I will speak of another insect that does a great deal of damage, particularly to fruit growers in the eastern part of the State; I do not know but you are exempt from it here. I refer to it to show that a large portion of these insects must be attacked in the winged state. Take, for instance, the rose bug. That insect cannot be destroyed,— I think I state it advisedly, because he has put me to a good deal of trouble, and I have looked him up,— he cannot be destroyed except in the winged state. Why? You must study his habits. I have investigated them and I find they are exactly as Harris says in his book on insects. In eastern Massachusetts the insects make their appearance about the 10th of June, and they increase in numbers until the 1st of July, when they are very plenty. In July they pair, and sometime in the latter part of July they lay their eggs. Those eggs are deposited near the surface of the ground, hatch in a very short time, and a little short grub, not more than a quarter of an inch long, goes beneath the surface, and he remains there until he gets to be larger. He is in the soil, and you cannot get at him to kill him. I want you should remember that. Then, sometime in October, I think, they go down below the region of frost, usually; and the next spring, at the proper time, they have gone through their transformation and come out of the ground again a perfect rose bug. The females lay about forty eggs, so that if you have caught two of those rascals, you will have about eighty less to deal with the next year. If they do not get low enough in the soil they are killed by the frost, and you are exempt for a few years. That is the reason why rose bugs are very plenty perhaps for two or three years, and then, all at once, you do not see any of them for three or four years. The simple reason is, or is supposed to be, that they have been killed by the frost before they get through with their transformation.

Now, that applies to all these insects, and about the only way that you can get ahead of them is to take them in the winged state. The rose bug cannot be destroyed in any other way that I know of. I have seen an apple tree literally covered with them, so that you could not more than half see the leaves, and they are very destructive in vineyards. There is where I have been brought in contact with them. I never have had half as many of them as my neighbors. They are local in their habits, and they stay in one locality, unless they are carried forward by warm southwest winds. They are lazy; they do not fly well; they want some encouragement; they want something more than their wings; they want to be propelled by the wind; then they come down on my vineyard, of which I have ten acres in one piece, and they uniformly strike on the first row of vines in that vineyard, on the southwest side of it, and I find most of them there. They come along just as the grape is blossoming, somewhere from the 20th to the 25th of June. That is the time they do us the most harm. They eat the buds before they open, and they eat them after they open; but after the grape has got the size of a buckshot they do not trouble it at all. There is but one way that I could ever find to get rid of them, and that is to pick them off and put them into water or kerosene. They will swim around in the water all night if you leave them there, and you must go around the next day; but it is a very safe way if you put them into the stove and burn them up and are careful of the ashes.

Mr. Cushman. In regard to the white grub, to which reference has been made, I would say that my farm is particularly adapted to that worm. The soil is of a light, sandy, warm nature, and the white grub seems to revel in it; and while I have studied in books all that I could read and learn of its habits and its character, I never yet have been able to find anything written of practical value to me in my efforts to exterminate that pest. I have had a remedy of my own; and my only fear in telling you of the remedy is that you will think it is too simple and too inexpensive, because you all have it or ought to have it on your farms. Capt. Moore's remedy, which was something new to me, will be better than mine, because it provides for killing the beetle; I have to kill the worm. It has been my practice to turn hogs on to the ground where I have seen the depredations of the white worm. I have had mowing lands that have been in precisely the same condition as has been described. You could roll the sod up; there was nothing left but a small portion of the roots just below the surface. I turn on two hogs to the acre through the month of August and early part of September, and give them just food enough to keep them hungry, just in good working condition, and they work constantly, almost, day and night, for those worms, and eat them with as much relish and as great avidity as if it had been corn. Then, if you do not choose to plough the land, if you still wish to keep it in meadow, all you have got to do is to apply a light coating of some fertilizer, sow your seed, go on with a heavy bush, and the next year you will have a meadow newly seeded; you have destroyed the worm, and the grass has actually been benefited instead of injured. In my twenty-five acres of corn this year I had but about an acre, — which was an outlying piece where I never had practised this method, — that was troubled with worms; whereas, there were a good many fields in my neighborhood, where a man could go in and take the rows right along, pull them up and throw them into heaps with his hands. The roots were entirely cut off and the crops destroyed by these pests.

That is the most simple, the most inexpensive, and I may say, perhaps, the most efficient remedy that I have ever been able to discover, and at the same time the grass seems to thrive and flourish. It helps the land if you wish to plant it the next year; and if you do not, if you will pursue the method I have described, you will find that it will help your meadow land.

Adjourned, *sine die.*

ANNUAL MEETING OF THE BOARD.

ANNUAL REPORT.

The Board met at the office of the Secretary, in Boston, Tuesday, Feb. 3, 1884, at 12 o'clock, A. M., was called to order by the Secretary, and, in the absence of the Governor, Hon. J. S. GRINNELL was chosen to preside.

Present: Messrs. Barrus, Bird, Bowen, Bowditch, Buddington, Damon, Edson, Grinnell, Goddard, Haskell, Hersey, Hill, Lane, Lynde, Moore, McKinstry, Noble, Nye, Round, Slade, Smith, Varnum, Ware, Warner.

Voted, To dispense with the reading of the minutes of the last meeting, the matter having all been printed in the annual report for 1883.

Voted, To appoint a committee of three to arrange the order of business of the meeting. Messrs. Moore, Damon and Bird were appointed.

Voted, To appoint a committee of three to examine and report on the credentials of newly elected members: Messrs. Slade, Lynde and Barrus.

The Board then adjourned until 2 o'clock, P. M.

The Board was called to order at 2 o'clock, P. M., Mr. GRINNELL in the chair. The Committee on the Order of Business reported through their chairman, Mr. Moore.

REPORT OF COMMITTEE ON ORDER OF BUSINESS.

The hours of meeting shall be as follows: First day, 12 to 1 o'clock, and from 2.30 to 4.30, P. M. Second and succeeding days, from 9½ to 2 o'clock.

FIRST DAY.

Records of last meeting.
Appointment of Committee on Credentials.
Reports of delegates and disposal thereof.
Report of Committee on Credentials.
Communications, etc.

SECOND DAY.

Appointment of Committee on Assignment of Delegates.
Appointment of Committee on Time and Place of holding Country Meeting.
Appointment of Committee on Change of Time for holding Fairs.
Appointment of Committee on Essays.
Reports, Essays, etc.

THIRD DAY.

Appointment of Executive Committee.
Election of Secretary.
Experiment Station Report.
Reports of Committees.
Miscellaneous and unfinished business.

In the discussion of all matters before the Board, speakers are to be limited to five minutes each.

JOHN B. MOORE,
DANIEL E. DAMON,
S. P. BIRD,
Committee.

A communication to the Secretary from the Chief of the Bureau of Labor Statistics was presented, read and laid on the table to be considered in the order of miscellaneous business.

Reports of delegates to the annual fairs being in order, Mr. Smith reported on the Berkshire Society. Mr. Warner reported on the Bristol Society. This report was discussed, and as a result of the discussion a committee consisting of Messrs. Ware, Smith and Nye was appointed to frame rules regulating the action of societies in testing the strength of horses and oxen.

The Committee on Credentials to which was referred the credentials of newly elected members, reported the following duly elected : —

J. R. Nichols, appointed by the Executive.
Ethan Brooks of West Springfield, by the Hampden Society.
Harvey M. Owen of Lanesborough, by the Berkshire Society.
J. Henry Hill of Amesbury, by the Amesbury and Salisbury Society.
Edmund Hersey of Hingham, by the Hingham Society.
Merritt I. Wheeler of Great Barrington, by the Housatonic Society.
E. W. Wood of Newton, by the Massachusetts Horticultural Society.
Jonathan D. Porter of Hatfield, by the Hampshire, Franklin and Hampden Society.
John B. Moore of Concord, by the Middlesex Society.
Daniel Upton of Adams, by the Hoosac Valley Society.
R. E. Burgess of Nantucket, by the Nantucket Society.
Daniel E Damon of Plymouth, by the Marshfield Society.
William R. Sessions of Hampden, by the Hampden East Society.
George W. Hobbs of Uxbridge, by the Blackstone Valley Society.
E. F. Bowditch of Framingham, by the Massachusetts Society.

The report was accepted.

Reports of delegates on the annual fairs were continued. Mr. Grinnell reported on the Deerfield Valley ; Dr. Lynde reported on the Essex Society ; Mr. Round reported on the Hampden Society.

The Secretary brought before the Board the first annual report of the Treasurer of the Blackstone Valley Agricultural Society, and asked for instruction of the Board in regard to the payment of the bounty to that society. The matter was referred back to the Secretary.

Mr. Round read an essay upon the Unimproved Lands of the Commonwealth. Laid on the table.

Mr. McKinstry reported on the Hampden East Society, which was laid on the table.

Mr. Damon reported on the Hampshire Society, Mr. Haskell (for Mr. Goddard) reported on the Hampshire, Franklin and Hampden Society ; Mr. Haskell reported on the Marshfield Society.

The Board then adjourned.

SECOND DAY.

The Board met at the office of the Secretary, at 9.30 A. M., Mr. GRINNELL in the chair.

Present: Messrs. Barrus, Bird, Bowen, Bowditch, Brooks, Buddington, Damon, Edson, Grinnell, Goddard, Hartshorn, Hersey, Hill, Hobbs, Lane, Lynde, Moore, McKinstry, Nye, Porter, Owen, Slade, Smith, Varnum, Ware, Warner, Wheeler, Wilder, Waterman and Wood.

The minutes of the previous day were read and accepted.

Voted, To appoint a committee of three on the assignment of delegates to the annual fairs: Messrs. Warner, Damon and Buddington.

Voted, To appoint a committee upon changes in time for holding fairs: Messrs. Wheeler, Edson and Varnum.

Voted, To appoint a committee of five on time and place for holding the Country Meeting: Messrs. Moore, Smith, Goddard, Wheeler and Barrus.

Mr. Wilder, having come in, was called to preside.

Reports of delegates being in order, Mr. Hill reported on the Highland Society and Mr. Hartshorn reported on the Hingham Society.

The Governor, on being announced, took the chair.

Mr. Grinnell reported on the Hoosac Valley Society and Mr. Noble reported on the Worcester Society.

Mr. Grinnell resumed the chair.

Mr. J. B. Moore, president of the Massachusetts Horticultural Society, invited the members of the Board to the free use of the library of the Horticultural Society.

Voted, To appoint a committee of two on essays: Dr. Lynde and Mr. Goddard.

A. C. Varnum reported on the Barnstable Society, Mr. Slade reported on the Housatonic Society, Mr. Hersey reported on the Middlesex North Society, Mr. Lane reported on the Middlesex South Society, Mr. Bird reported on the Plymouth Society, Mr. Edson reported on the Union Society.

The Committee upon Changes in the Time of holding Fairs, reported the following changes: —

HAMPDEN, from Sept. 9th and 10th to Sept. 23d and 24th.
DEERFIELD VALLEY, from Sept. 18th and 19th to Sept. 15th and 16th.
HOOSAC VALLEY, from Sept. 16th and 17th to Sept. 17th and 18th.
UNION, from Sept. 17th and 18th to Sept. 9th, 10th and 11th.
MIDDLESEX NORTH from Sept. 9th and 10th to Sept. 16th and 17th.

This report was considered by separate items, and the changes recommended for the Deerfield Valley and the Hoosac Valley were not allowed. The other changes recommended were voted.

On motion, the decision of the Board in respect to the changes in the time of the Deerfield Valley and Hoosac Valley was reconsidered, and the matter assigned to 9.30 on Thursday.

Voted, That a possible change in time of holding Worcester Society Fair, to accommodate the New England Fair, be referred to the Executive Committee with full powers.

Mr. Nye reported on the Worcester North Society, Mr. Bowditch reported on the Worcester Northwest Society, Mr. Ware reported on the Worcester South Society, Mr. Sessions reported on the Hillside Society, Mr. Bowen reported on the Worcester West Society, Mr. Buddington reported on the Nantucket Society.

Meeting adjourned until 9.30, Thursday.

THIRD DAY.

Board met at 9.30, at the office of the Secretary.

Present: Messrs. Barrus, Bird, Bowen, Bowditch, Brooks, Buddington, Damon, Edson, Grinnell, Goddard, Hartshorn, Hersey, Hill, Lane, Lynde, McKinstry, Moore, Nye, Owen, Porter, Slade, Sessions, Smith, Varnum, Ware, Warner and Wheeler.

Minutes of the previous day were read and accepted.

The communication made by the Commissioner of Labor Statistics was taken from the table and a committee of three was appointed to confer with the commissioner: Hersey, Slade and Sessions.

On motion, Mr. Grinnell was added to the committee.

The reconsideration of the change of time for holding the Deerfield Valley and Hoosac Valley fairs being in order, voted that no changes be allowed.

Upon motion of Mr. Smith, it was resolved that no agricultural society in this Commonwealth shall receive the State bounty, that holds a third or benefit day not recognized by this Board, when such day occurs the same day as the regular appointed day for holding a fair in an adjoining society.

Voted, That the Executive Committee have power to change the day or days of holding fairs of any society for the year.

Voted, That the two vacancies in the Executive Committee of the Agricultural College, made by the retirement of Messrs. Sessions and Damon, be filled by nomination by the chairman. Messrs. Sessions and Damon were re-appointed.

Prof. Goessmann, Director of Experiment Station, read his annual report on the work of the Experiment Station, which was adopted.

Prof. Goessmann also presented his Twelfth Annual Report on Commercial Fertilizers, which was laid upon the table.

Dr. Davenport, Milk Inspector of the city of Boston, was invited to address the Board upon the current adulteration of milk.

After discussion it was voted to appoint a committee of three to report resolutions for the consideration of the Board: Messrs. Ware, Moore and Bowditch.

On motion, the thanks of the Board were presented to Dr. Davenport.

The Committee on the Place and Time for holding the Country Meeting reported, recommending that the meeting be held at Barre, on the 1st, 2d and 3d of December next.

Their report was laid on the table.

Mr. Buell reported on the Fair of the Martha's Vineyard Society.

The Treasurer's report of the Experiment Station was presented to the Board. Approved and adopted.

Voted, That the Secretary of this Board be directed to send to the Secretary of each society the report of the visiting delegate to that society.

Voted, To appoint a committee of two to report the names of five members to compose an Executive Committee that shall also be a Committee on Printing: Messrs. Smith and Bird.

The report of the Committee upon the Country Meeting was taken from the table, discussed, and amended by substituting the word Framingham for that of Barre; in this form it was adopted.

The committee appointed to report concerning the sale of pure milk submitted the following:—

That this Board urge that measures be adopted by the Legislature, for the enforcement of the laws regulating the sale of milk in this Commonwealth with sufficient appropriation to carry them into effect.

Voted, To appoint a committee of five to appear before the Commitee of the Legislature, and urge the amendments of the laws regulating the inspection of milk: Messrs. Moore, Lynde, Hartshorn, Varnum and Bowditch.

Mr. Barrus was elected a member of the Board of Control of the Experiment Station.

Mr. Sessions, of the Committee on the Agricultural College, made the annual report on the farm and college, which was accepted.

The Board proceeded to the election of Secretary: Mr. John E. Russell was elected.

The committee to report the names of five members to serve as a Committee on Printing and Executive Committee, reported the names of Messrs. Wilder, Moore, Hersey, Slade and Bowditch.

The Committee on Essays reported the following subjects and assignments : —

"Fruits of the Orchard and Farm."	J. H. Hill.
"The Barn for the Farmer."	J. Buddington.
"Trotting Horses."	D. E. Damon.
"The Corn Crop."	S. B. Bird.
"Farm Life."	Ethan Brooks.
"Raising Calves."	E. F. Bowditch.

The Committee on Rules to govern Societies in testing the Strength of Horses and Cattle made a report, which was indefinitely postponed.

Adjourned.

FOURTH DAY.

Present: Messrs. Barrus, Bird, Brooks, Grinnell, Goddard, Hartshorn, Hersey, Hill, Lane, Lynde, Moore, Owen, Porter, Smith, Varnum, Warner and Wheeler.

Voted, To appoint a committee of five on Country Meeting. Committee: Messrs. Bird, Bowditch, Moore, Lane and Hersey.

Mr. Warner, from Committee on Assignment of Delegates, reported the following, which was accepted :—

Amesbury and Salisbury,	Jonathan Buddington.
Barnstable,	Daniel Upton.
Berkshire,	W. L. Warner,
Blackstone Valley,	W. S. Bowen.
Bristol,	John O. McKinstry.
Deerfield Valley,	Daniel E. Damon.
Essex,	E. A. Davis.
Franklin,	John B. Moore.
Hampden,	J. H. Goddard.
Hampden East,	Nathan Edson.
Hampshire,	J. P. Lynde.
Hampshire, Franklin and Hampden,	Lewis C. Nye.
Highland,	C. L. Hartshorn.
Hingham,	John Lane.

Hillside, ...	S. B. Bird.
Hoosac Valley, ...	E. F. Bowditch.
Housatonic, ...	E. W. Wood.
Marshfield, ...	Ethan Brooks.
Martha's Vineyard, ...	H. M. Owen.
Massachusetts Horticultural, . . .	J. S. Grinnell.
Middlesex, ...	R. E. Burgess.
Middlesex North, ...	M. I. Wheeler.
Middlesex South, ...	Alvan Barrus.
Nantucket, ...	Arthur A. Smith.
Plymouth, ...	Benj. P. Ware.
Union, ...	Edmund Hersey.
Worcester, ...	J. H. Hill.
Worcester North, ...	Wm. R. Sessions.
Worcester Northwest, ...	A. C. Varnum.
Worcester South, ...	Avery P. Slade.
Worcester West, ...	J. D. Porter.

Mr. Barrus read an Essay upon the Farm and City, which was accepted.

Voted, That a committee of five be appointed to assist before the Committee of the Legislature to procure an adequate amount of money for the use of the Experiment Station: Messrs. Moore, Lynde, Hartshorn, Varnum and Bowditch.

Papers that had been read and laid upon the table were taken up, read by their titles and accepted.

Voted, That all unfinished business be referred to the Executive Committee, with full powers.

Adjourned.

JOHN E. RUSSELL,
Secretary.

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amounts received from the Commonwealth.	Income from Permanent Fund.	New Members and Donations.	All other Sources.	Receipts for the Year.	Premiums Offered.	Premiums and Gratuities Paid.	Current Expenses for the Year, not including Premiums and Gratuities.	Disbursements for the Year.	Indebtedness.	Value of Real Estate.	Value of Personal Estate.	Permanent Fund.
Amesbury and Salisbury, . .	$200 00	$55 32	$25 50	$330 05	$609 87	$500 00	$261 05	$300 00	$561 42	-	-	$1,229 72	$1,229 72
Barnstable, . .	600 00	16 00	165 35	1,466 30	2,247 65	754 50	807 55	993 29	1,800 84	-	-	-	6,000 00
Berkshire, . .	600 00	747 01	246 00	-	4,197 76	3,440 00	3,052 00	-	-	-	$8,000 00	250 00	8,747 01
Bristol, . . .	600 00	-	292 65	7,575 57	8,468 22	4,500 00	3,695 05	4,346 19	8,739 89	$14,000 00	46,000 00	750 00	32,000 00
Blackstone Valley,	-	-	540 66	805 23	1,345 89	396 55	260 91	346 23	607 14	1,800 00	3,000 00	200 00	3,000 00
Deerfield Valley, .	600 00	-	218 38	935 39	1,753 77	800 00	699 84	714 83	1,414 67	-	8,080 00	439 10	8,080 00
Essex, . . .	600 00	1,382 46	204 50	865 67	3,052 63	2,753 00	1,401 25	774 38	2,175 53	-	5,000 00	1,000 00	18,303 05
Franklin, . .	600 00	25 00	106 00	1,587 73	2,318 73	1,062 00	890 00	1,006 11	1,896 11	-	10,000 00	1,000 00	11,000 00
Hampden, . .	408 66	-	30 50	272 66	711 82	1,975 75	578 28	650 62	1,228 90	-	-	-	-
Hampden East, .	600 00	-	105 33	857 11	1,562 44	1,233 25	982 80	701 13	1,656 77	175 00	5,000 00	-	5,000 00
Hampshire, . .	600 00	-	162 90	969 20	1,732 10	819 00	621 95	1,105 77	1,727 72	1,025 54	4,100 00	150 00	3,276 00
Hampshire, Franklin and Hampden,	600 00	329 00	77 00	-	2,617 19	1,258 50	645 75	1,400 00	2,441 75	6,495 00	7,800 00	300 44	8,100 44
Highland, . .	570 20	-	61 00	1,215 14	1,846 34	918 30	711 90	1,042 42	1,754 32	-	2,500 00	800 00	3,300 00
Hingham, . .	600 00	-	421 70	3,900 15	4,921 85	1,726 05	732 07	4,059 28	4,791 35	1,200 00	16,000 00	2,000 00	16,800 00
Hoosac Valley, .	600 00	-	338 00	4,377 48	5,315 48	1,726 50	1,301 15	1,893 08	5,106 06	3,600 00	12,900 00	450 00	-
Housatonic, . .	600 00	1,122 99	260 34	3,914 59	5,897 92	3,987 00	3,368 00	3,403 69	6,752 92	-	8,500 00	1,064 25	9,564 25
Hillside, . .	393 45	202 23	940 00	1,083 78	2,819 46	609 50	609 00	3,371 50	3,980 50	800 00	3,012 42	203 66	3,113 32
Marshfield, . .	600 00	-	75 00	1,950 80	2,625 80	1,175 50	837 37	2,094 89	2,932 26	4,806 46	11,806 92	1,392 78	8,393 24
Martha's Vineyard,	600 00	211 56	22 00	328 76	1,162 32	824 25	651 19	380 11	1,031 30	-	2,200 00	1,521 96	3,721 96
Middlesex, . .	600 00	-	136 00	3,191 81	3,327 81	1,598 00	747 10	2,637 74	3,384 84	20,500 00	15,000 00	-	3,500 00
Middlesex North, .	600 00	775 00	19 00	264 56	1,658 56	1,189 00	472 75	1,408 34	1,881 09	1,200 00	20,000 00	150 00	20,000 00
Middlesex South, .	600 00	-	66 60	1,117 22	1,783 82	1,100 00	897 75	646 66	1,420 01	13,000 00	18,000 00	-	-
Nantucket, . .	600 00	40 00	32 00	403 79	1,075 79	1,244 25	600 90	388 08	1,227 71	400 00	3,000 00	200 00	3,200 00
Plymouth, . .	600 00	200 00	85 65	4,583 71	5,469 36	3,126 00	2,303 44	2,805 21	5,108 65	7,850 00	43,000 00	2,000 00	45,000 00
Union, . . .	600 00	-	126 22	1,390 15	2,116 37	1,342 75	913 83	1,198 37	2,112 20	-	6,697 59	1,532 89	8,230 48
Worcester, . .	600 00	1,261 30	350 00	2,958 42	5,189 72	2,851 50	1,868 88	3,843 46	5,857 25	35,000 00	120,000 00	15,000 00	100,000 00

Worcester North,	600 00	-	268 42	1,145 13	1,989 98	1,376 50	982 70	1,303 56	2,296 26	11,500 00	16,000 00	50 00	186 12
Worcester Northwest, . . .	600 00	-	107 50	3,054 03	3,761 53	1,685 50	1,285 31	1,290 02	3,175 33	4,200 00	12,500 00	2,037 67	10,337 67
Worcester South, .	600 00	2,300 00	220 00	4,254 19	5,074 19	2,084 00	1,744 40	1,266 61	4,400 49	-	14,500 00	1,000 00	15,500 00
Worcester South-East, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-
Worcester West, .	600 00	203 55	26 00	1,166 09	1,995 64	1,482 50	1,071 50	589 25	1,660 75	1,021 62	11,600 00	750 00	11,600 00
	$6,572 31	$8,871 42	$5,730 20	$55,964 71	$88,650 01	$49,539 65	$34,995 67	$45,960 82	$82,124 03	$128,573 62	$434,196 93	$35,472 47	$367,183 26

PERMANENT FUND—HOW INVESTED.

AMESBURY AND SALISBURY.—Deposited in bank.

BARNSTABLE.—Real estate and government bonds.

BERKSHIRE.—Real estate.

BLACKSTONE VALLEY.—In land.

BRISTOL.—

DEERFIELD VALLEY.—In real estate.

ESSEX.—In farm and bank stock.

FRANKLIN.—In real estate, park and bank stock.

HAMPDEN.—

HAMPDEN EAST.—In fair grounds and buildings.

HAMPSHIRE.—In real estate.

HAMPSHIRE, FRANKLIN AND HAMPDEN.—In real estate.

HIGHLAND.—In real estate and bank stock.

HILLSIDE.—In land and buildings.

HINGHAM.—In land and buildings.

HOOSAC VALLEY.—

HOUSATONIC.—Real estate, railroad bonds and bank funds.

MARSHFIELD.—In land and buildings.

MARTHA'S VINEYARD.—In land and buildings.

MASSACHUSETTS HORTICULTURAL.—

MIDDLESEX.—

MIDDLESEX NORTH.—In land and buildings.

MIDDLESEX SOUTH.—In land and buildings.

NANTUCKET.—In land and buildings.

PLYMOUTH.—In real estate.

UNION.—In real estate, personal property and cash.

WORCESTER.—In real estate.

WORCESTER NORTH.—In real estate and cash.

WORCESTER NORTHWEST.—In land and buildings.

WORCESTER SOUTH.—In land and buildings.

WORCESTER WEST.—In real estate.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total Amount offered for Management and Improvement of Farms, Orchards, etc.	Total amount paid for Management and Improvement of Farms, Orchards, etc.	For Neat and Dairy Stock.	For Horses.	For all other Farm Stock.	Total Amount offered for Live Stock.	Total Amount paid out for Live Stock.	For Cereals and Seeds.	For Roots and Vegetables.	Total Amount offered for Grain and Root Crops.	Total Amount paid out for Grain and Root Crops.	For Fruits, Flowers, etc.	For Dairy Products.	For Bread, Honey and Preserved Fruits, etc.	Total Amount paid out under the head of Farm Products.
Amesbury and Salisbury, . .	$60 00	$45 00	-	-	-	$45 00	$5 75	$18 50	$16 50	$140 00	$34 00	$66 10	-	$7 50	$107 60
Barnstable, . .	143 00	30 50	$105 00	$61 00	$103 25	376 00	269 25	48 90	54 00	228 50	102 90	67 65	$12 00	28 00	210 55
Berkshire, . .	251 00	250 00	539 00	259 00	303 00	1,349 00	1,101 00	163 00	101 00	414 00	-	136 00	55 00	54 00	509 50
Bristol, . . .	160 00	131 00	596 00	182 00	208 50	1,550 00	975 00	36 00	99 75	260 00	135 75	178 00	37 00	41 00	391 75
Blackstone Valley,	-	40 00	77 00	37 00	45 20	167 25	127 80	7 00	23 50	23 75	30 50	36 00	5 00	8 25	79 75
Deerfield Valley, .	-	-	191 00	129 00	124 30	479 00	444 30	6 00	7 25	25 25	19 25	39 75	15 00	16 50	148 25
Essex, . . .	872 00	122 00	258 00	104 00	115 00	664 00	458 00	40 00	176 50	382 00	203 00	340 00	24 00	23 50	590 50
Franklin, . .	-	-	170 00	140 00	255 00	674 00	550 00	16 00	23 00	69 00	64 00	110 50	15 00	19 00	217 25
Hampden, . .	280 00	25 50	62 00	74 00	34 00	837 50	157 50	8 25	29 50	230 75	25 62	183 25	3 00	9 00	196 38
Hampden East, .	119 00	21 00	153 00	109 00	158 00	507 00	420 00	29 25	24 75	97 50	62 75	48 50	9 00	13 10	124 85
Hampshire, . .	-	-	77 00	95 00	149 00	496 00	288 00	12 00	22 50	47 00	43 00	66 50	12 00	21 00	145 25
Hampshire, Franklin and Hampden,	20 00	-	194 00	174 00	148 50	671 00	434 50	29 50	34 50	231 00	48 50	73 00	21 50	16 50	136 25

Highland, . .	40 00	34 00	173 00	110 00	119 00	554 00	402 00	20 50	23 25	54 00	43 75	19 50	8 50	12 80	84 55
Hingham, . .	199 75	12 00	168 00	65 00	179 70	879 75	412 70	11 00	43 00	177 00	54 00	129 35	10 00	24 25	217 60
Hoosac Valley, .	67 00	62 00	144 00	160 00	257 00	811 00	561 00	139 25	81 00	235 00	220 25	87 25	40 00	45 50	393 00
Housatonic, . .	223 00	171 00	410 00	197 00	667 00	2,198 00	1,781 00	430 00	166 00	608 00	596 00	203 00	65 00	61 00	989 00
Hillside, . .	-	-	186 00	128 00	66 00	327 00	380 00	15 10	17 25	35 00	32 10	39 50	23 00	22 65	133 25
Marshfield, . .	73 00	25 75	162 00	53 00	80 75	482 50	251 75	13 00	57 25	99 00	47 50	95 55	19 00	35 50	150 00
Martha's Viney'd,	57 00	10 00	154 25	50 00	123 25	379 75	327 40	34 00	45 70	148 00	54 00	56 15	15 50	22 95	184 30
Middlesex, . .	93 00	18 00	102 00	66 00	155 00	625 00	267 00	5 00	48 00	136 00	66 00	202 00	5 00	26 00	298 00
Middlesex North,	12 00	6 00	165 00	151 00	80 00	755 00	216 00	15 00	43 50	108 00	80 00	158 00	5 00	46 50	179 25
Middlesex South,	48 50	48 50	173 00	73 00	92 50	552 00	338 50	14 25	70 50	150 00	84 75	73 45	6 00	24 75	172 45
Nantucket, . .	108 00	-	105 00	43 50	34 50	564 00	182 00	8 50	29 75	225 75	38 25	46 00	15 00	16 00	153 50
Plymouth, . .	181 00	-	409 00	155 00	193 50	920 00	757 50	88 00	126 75	369 00	158 00	173 75	41 00	26 00	455 50
Union, . . .	16 00	-	225 00	119 00	81 50	736 50	415 75	21 00	20 00	81 00	62 25	21 50	11 50	9 30	104 30
Worcester, . .	-	-	515 00	115 00	74 50	1,461 00	1,511 38	19 00	69 00	203 00	109 50	285 50	15 00	11 00	334 25
Worcester North,	24 00	24 00	77 00	73 50	134 50	465 00	287 50	12 50	51 00	112 00	92 50	131 00	3 00	10 50	144 50
Worcester North-west, . .	22 00	22 00	280 00	125 00	136 50	800 00	515 31	39 00	8 00	57 00	44 98	46 75	17 00	12 00	115 23
Worcester South,	100 00	-	367 00	208 00	154 30	987 00	729 30	13 00	16 75	58 00	31 00	88 25	32 00	22 00	203 00
Worcester South-east, . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worcester West, .	65 00	-	304 00	112 00	66 75	642 00	487 75	8 00	13 00	79 00	19 50	33 75	21 00	12 00	82 25
	$3,234 25	$1,098 25	$6,541 25	$3,368 00	$4,340 00	$20,955 25	$14,054 94	$1,320 50	$1,542 45	$5,083 50	$2,603 60	$3,235 50	$561 00	$698 05	$7,251 81

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED — *Concluded.*

SOCIETIES.	For Agricultural Implements.	Offered for raising Forest Trees.	For Experiments on Manures.	Amount awarded for Objects strictly Agricultural not already specified.	Amount awarded and paid out for Trotting Horses.	For Objects not strictly Agricultural: Domestic Manufactures.	Number of Persons who received Premiums and Gratuities.
Amesbury and Salisbury, ...	$10 00	$43 00	-	$30 00	-	$64 20	291
Barnstable, . . .	5 25	7 00	-	6 00	$165 00	121 00	483
Berkshire, . . .	29 00	-	-	-	600 00	562 50	-
Bristol, ...	150 00	23 00	$60 00	-	1,710 00	517 75	475
Blackstone Valley, .	-	-	-	-	-	13 36	178
Deerfield Valley, . .	-	-	-	18 00	45 00	44 29	300
Essex, ...	24 00	30 00	25 00		-	229 00	362
Franklin, . . .	-	10 00	-	-	600 00	109 00	200
Hampden, . . .	46 00	30 00	15 00	38 00	-	120 00	100
Hampden East, . .	20 00	25 00	-	6 00	320 00	70 95	149
Hampshire, . . .	-	8 00	-	13 00	215 00	142 45	164
Hampshire, Franklin and Hampden, . .	15 50	20 00	-	-	472 50	102 75	141
Highland, . . .	6 00	-	-	-	25 00	160 35	212
Hingham, . . .	-	40 00	-	-	-	89 77	331
Hoosac Valley, . .	20 00	-	10 00	31 50	920 00	234 65	291
Housatonic, . . .	-	-	-	46 00	507 00	481 00	493
Hillside, . . .	21 00	-	-	-	-	76 00	230
Marshfield, . . .	6 00	50 00	-	-	203 00	143 03	453
Martha's Vineyard, .	3 00	11 00	10 00	-	-	126 49	183
Middlesex, . . .	17 00	50 00	-	-	550 00	100 00	139
Middlesex North, . .	-	-	-	-	-	4 95	243
Middlesex South, . .	7 00	45 00	-	-	235 00	49 80	171
Nantucket, . . .	-	13 00	15 00	242 75	-	-	260
Plymouth, . . .	-	60 00	-	-	777 00	252 44	426
Union, ...	9 75	-	-	-	235 00	161 50	260
Worcester, . . .	24 00	11 00	-	-	625 00	45 00	173
Worcester North, .	12 00	25 00	-	-	175 00	190 35	237
Worcester Northwest, .	8 25	30 00	-	-	590 00	51 65	179
Worcester South, . .	13 50	35 00	-	-	525 00	91 45	-
Worcester Southeast, .	-	-	-	-	-	-	-
Worcester West, . .	9 75	30 00	10 00	-	480 00	64 20	190
	$457 00	$596 00	$145 00	$431 25	$9,974 50	$4,419 88	6,314

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AGRICULTURAL EXHIBITIONS, 1885.

AMESBURY AND SALISBURY at *Newburyport*, October 6 and 7.
BARNSTABLE at *Barnstable*, September 29 and 30.
BERKSHIRE at *Pittsfield*, September 15 and 16.
BLACKSTONE VALLEY at *Uxbridge*, September 30 and October 1.
BRISTOL at *Taunton*, October 6 and 7.
DEERFIELD VALLEY at *Charlemont*, September 24 and 25.
ESSEX at *Newburyport*, September 22 and 23.
FRANKLIN at *Greenfield*, October 1 and 2.
HAMPDEN at *Chicopee*, September 23 and 24.
HAMPDEN EAST at *Palmer*, September 22 and 23.
HAMPSHIRE at *Amherst*, September 24 and 25.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, October 7 and 8.
HIGHLAND at *Middlefield*, September 9 and 10.
HINGHAM at *Hingham*, September 29 and 30.
HOOSAC VALLEY at *North Adams*, September 22 and 23.
HOUSATONIC at *Great Barrington*, September 30 and October 1.
HILLSIDE at *Cummington*, September 29 and 30.
MASSACHUSETTS HORTICULTURAL.
MARSHFIELD at *Marshfield*, September 16, 17 and 18.
MARTHA'S VINEYARD at *West Tisbury*, October 6 and 7.
MIDDLESEX at *Concord*, September 29 and 30.
MIDDLESEX NORTH at *Lowell*, September 16 and 17.
MIDDLESEX SOUTH at *Framingham*, September 22 and 23.
NANTUCKET at *Nantucket*, September 9 and 10.
PLYMOUTH at *Bridgewater*, September 23 and 24.
UNION at *Blandford*, September 9 and 10.
WORCESTER at *Worcester*, September 24 and 25.
WORCESTER NORTH at *Fitchburg*, September 29 and 30.
WORCESTER NORTHWEST at *Athol*, October 6 and 7.
WORCESTER SOUTH at *Sturbridge*, September 24 and 25.
WORCESTER WEST at *Barre*, October 1 and 2.

APPENDIX.

TWELFTH ANNUAL REPORT

ON

COMMERCIAL FERTILIZERS.

Gentlemen:—The expectation expressed in the last annual report (1883) has been realized; the cost of agricultural chemicals and of commercial fertilizers has been lower than in the preceding years. Better organizations in the trade, improvements in machinery, progress in the development of resources of manurial substances, and a fair chance for competition under the control of State laws for the regulation of the trade, are contributing to that result.

The list of compound fertilizers offered for sale in our markets has been somewhat less than in the previous year. This fact has to be ascribed mainly to the retirement of some New York and Philadelphia manufacturers, who in consequence of business depressions in the Southern States, had temporarily entered our State.

The consumption has been large and the general character of the fertilizers sold has been, in the majority of cases, fairly within the stated guaranty of the manufacturers. Some cases have been noticed, where articles had been changed by careless storing and accidental exposure; they have been investigated and the supposed injury adjusted to the satisfaction of the parties directly interested.

Reported attempts of selling fertilizer without complying with the laws of the State have been promptly acted upon by the Secretary of your Board, in whose hands the execution of the laws for the regulation of the trade in commercial fertilizers rests.

Arrangements have been perfected during the past year, for the introduction of a more uniform mode of analysis of fertilizers throughout the entire country. The rules adopted for that purpose at the first meeting of the Association of Official Agricultural Chemists at Philadelphia, Sept. 8th and 9th, 1884, are hereby recommended for your consideration; they will be followed hereafter, if not otherwise directed. These rules are in the majority of cases not different from those which have been applied during past years, in connection with the State inspection of fertilizers. The only noted change consists in the introduction of higher temperature, — 65° C. instead of 40° C. — for the determination of the reverted (or reduced) phosphoric acid. It is expected by many of the advocates of this change, that the result obtained by it, will secure more harmony among those interested in the commercial valuation of fertilizers. The object in view deserves a trial.

The prospects for an active trade in the spring are good. The stock of crude materials is reported equal to the demand; and the tendency regarding the cost of agricultural chemicals, as well as compound fertilizers, thus rather in favor of lower prices, when compared with those of preceding years.

BASIS OF VALUATION OF FERTILIZERS FOR 1884.

I.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per Pound.
Nitrogen in ammonia salts,	22
Nitrogen in nitrates,	18
Nitrogen in dried and fine ground fish,	20
Organic nitrogen in guano, and fine ground blood and meat,	18
Organic nitrogen in cotton seed, linseed meal and in castor pomace,	18
Organic nitrogen in fine ground bone,	18
Organic nitrogen in fine medium bone,	16
Organic nitrogen in medium bone,	14
Organic nitrogen in coarse medium bone,	12
Organic nitrogen in coarse bone, horn shavings, hair and fish scraps,	10
Phosphoric acid soluble in water,	10
Phosphoric acid soluble in ammonia citrate,*	09

* Dissolved from two grains of phosphate, unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in 30 minutes at 40° C., with agitation once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

	Cents per Pound.
Phosphoric acid insoluble in dry fine ground fish, and in fine bone,	06
Phosphoric acid insoluble in fine medium bone,	05½
Phosphoric acid insoluble in medium bone,	05
Phosphoric acid insoluble in coarse medium bone,	04½
Phosphoric acid insoluble in coarse bone,	04
Phosphoric acid insoluble in fine ground rock phosphate,	02¼
Potash in high grade sulphate,	07¼
Potash in kainite,	04¼
Potash in muriate,	04¼

The above trade values are the figures at which on March 1st, 1884, the respective ingredients could be bought at retail, for cash, in our markets in the raw materials, which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March first, plus about 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures, will be found to agree fairly with the reasonable retail price in case of standard raw materials, such as Sulphate of Ammonia, Azotin, Nitrate of Soda, Dry Ground Fish, Muriate of Potash, Cotton-seed Meal, Sulphate of Potash, Castor Pomace, Dried Blood, Bone, Plain Superphosphates.

The particular rate of valuation of raw materials used for manurial purposes, depends in many instances, aside from their composition, largely on their mechanical condition, and their peculiar form of combination and association; for instance, factory waste, animal and vegetable refuse of various description, etc. No general rule can be offered as a safe guide to approximate their cash value; each case ought to be decided on its own merits.

II.

TRADE VALUES OF AMMONIATED SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE, IN 1884.

The organic nitrogen in these classes of goods has been valued at the highest figure laid down in the above trade values of fertilizing ingredients in raw materials, namely, twenty cents per pound. Insoluble phosphoric acid has been valued at four and one-half (4½) cents, the cost of phosphoric acid in coarse medium bones; potash at four and one-quarter ($4\frac{1}{4}$) cents, its cost in the form of muriate of potash; higher valuations have been adopted only when special forms are *guaranteed* in the statement of the manufacturers, and found by analysis.

The use of the highest trade values is but justice to those articles in which the costliest materials are used. In most cases the calculated value of ammoniated superphosphates and special manures, falls considerably below their retail price. The difference between the two represents the manufacturer's claim for expenses incurred in converting raw materials into manufactured compound articles.

These expenses include grinding and mixing, bagging and barrelling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally profits.

The prices used in computing the value of the commercial fertilizers described in the subsequent report (1884) were approved by the officers in charge of the inspection of these articles in the States of Massachusetts, Connecticut and New Jersey, at their annual meeting.

The valuation attached to each analysis does not necessarily coincide with the manufacturer's view regarding that point; it shall essentially aid in a closer approximation of the money value of the constituents recognized by analysis. The cost of each is based on its market price in an efficient form, and may serve as a guide to farmers in supplying economically their wants.

Moisture in Fertilizers. — The quantity of moisture contained in a compound fertilizer exerts a controlling influence on the results of its analysis; and yet, comparatively speaking, but few manufacturers mention in their printed guaranty the approximate amount of that constituent in their articles upon which their guaranteed composition is based.

An article, for instance, which, with 10 per cent. of moisture analyzes 10 per cent. of soluble phosphoric acid, 2.5 per cent. of nitrogen, and 5 per cent. of potassium oxide, will analyze 9 per cent. of phosphoric acid, 2.25 per cent. of nitrogen, and 4.5 per cent. of potassium oxide, in case of containing 19 per cent. of moisture.

Statements of comparative tests regarding the *exact composition* of two fertilizers, are, for this reason, always made with a definite reference to a corresponding state of their moisture. Manufacturers who state the composition of the articles they offer for sale, without mentioning, at least approximately, the amount of moisture they contain, deprive the inspector of the chance to recognize exceptional conditions in their goods. The manufacturer of fertilizers is expected to state, in the interest of his customers, the total weight of the article contained in each package; besides — within certain limits — the amount of phosphoric acid, nitrogen and potassium oxide he offers for sale in each hundred weight. As long as the fertilizer is carefully stored, no serious alterations, either in total weight or in original composition, are expected within one season of keeping. Quite different, however, will be the result when it is stored in ill-constructed sheds, and damp storehouses, or meets with some accidental exposure to rain; for in that case the total weight of the package increases and the composition of its contents is reduced in strength in the same proportion as its percentage of water was increased. The chemical analysis refers to one hundred weight of the fertilizer; the customer who secures the entire package does not necessarily suffer; yet the manufacturer may suffer by a lower analysis of his goods in consequence of neglecting to furnish all the information needed to recognize the results of exceptional conditions.

In past years I have noticed, from time to time, instances where circumstances similar to those pointed out above have caused the deterioration of some of the fertilizers tested. During the past season my attention has again been called to a case of a similar character, which may be considered as the immediate cause of inserting here, once more, the previous discussion.

My last annual report contained an analysis (Bulletin No. 7) of a fertilizer, manufactured by the Clark's Cove Guano Co., New Bedford, Mass., called the "Bay State Fertilizer," and offered for sale by E. S. Snow, of Belchertown, Mass. This sample was collected by one of my assistants. Careful inquiry since, at the agent's storehouse, in connection with information from other sources, tend to show that the moisture (22 per cent.) noticed in the article was largely due to a deficiency in the store-room. Bags of fertilizer, which were subsequently weighed, showed from ten to fifteen pounds more than the bill of sale stated. I believe now, for above-stated reason, that the article originally furnished by the company was a fair specimen of its kind and within the customary guaranty of composition.

In making this statement, in justice to the manufacturer, I do not intend to convey the idea that the addition of a larger percentage of water exerts no other serious influence on a complete fertilizer than diluting the article, i. e., reducing its original strength; for changes of a more serious character are apt to occur. For instance, in case nitrates are forming a source of nitrogen in a fertilizer containing superphosphates, more or less of nitric acid will be rendered free, and thus directly and indirectly the amount of that costly ingredient reduced. The frequent occurrence of rotten bags in the fertilizer trade finds a satisfactory explanation in circumstances similar to those pointed out.

Manufacturers ought to see to it that their articles are kept in suitable store-rooms.

C. A. GOESSMANN,
State Inspector.

February 2, 1885.

Canada Wood Ashes.

(Collected of J. A. Sullivan, Northampton, Mass. Sold at 30 cents per bush.)

	Per cent.
Moisture,	7.98
Phosphoric acid,	1 82
Potassium oxide,	5.15
Calcium oxide,	36.84
Magnesium oxide,	3.31
Insoluble matter,	12.58

Canada Wood Ashes.

(Collected of E. Hobart, North Amherst, Mass.)

	Per cent.
Moisture,	28.57
Phosphoric acid,	1.07
Potassium oxide,	5.06
Calcium oxide,	27.02
Magnesium oxide,	2.75
Insoluble matter (in acids),	9.34

Canada Ashes.

(Collected of E. M. Rouche, South Deerfield, Mass.)

	Per cent.
Moisture at 100° C.,	10.72
Ash,	62.00
Calcium oxide,	40.88
Magnesium oxide,	3.33
Potassium oxide,	4.95
Phosphoric acid,	2.02
Insoluble matter,	6.30

Canada Ashes.

(Collected of A. Montague, Sunderland, Mass.)

	Per cent.
Moisture at 100° C.,	15.00
Ash calcined,	60.40
Calcium oxide,	35.22
Magnesium oxide,	3.24
Potassium oxide,	5.50
Phosphoric acid,	2.53
Insoluble matter,	9.05

Fish Pomace.

(From W. L. Brightman's Works, Tiverton, R. I.; collected of O. P. Gardner, Somerset, Mass.)

	Per cent.
Moisture at 100° C.,	45.10
Nitrogen,	5.17
Total phosphoric acid,	3.66
Reverted phosphoric acid,	1.73
Insoluble phosphoric acid,	1.93

Valuation per two thousand pounds: —

103.4 pounds of nitrogen,	$20 68
34.6 pounds of reverted phosphoric acid,	3 11
38.6 pounds of insoluble phosphoric acid,	1 74
	$25 53

Dry Pure Ground Fish.

(Williams, Clark & Co., New York; collected of Slate & DeWolf, Greenfield, Mass.)

Guaranteed composition: Ammonia, 10 to 12 per cent. (equivalent to nitrogen, 8 to 10 per cent:); bone phosphate, 13 to 16 per cent. (equivalent to phosphoric acid, 6 to 7.3 per cent.).

	Per cent.
Moisture at 100° C.,	12.33
Total phosphoric acid,	8.95
Reverted phosphoric acid,	4.57
Insoluble phosphoric acid,	4.38
Nitrogen,	7.50
Insoluble matter,	1.65

Valuation per two thousand pounds: —

91.4 pounds of reverted phosphoric acid,	$8 23
87.6 pounds of insoluble phosphoric acid,	3 94
150. pounds of nitrogen,	30 00
	$42 17

Quinnipiac Dry Ground Fish.

(Collected of D. A. Horton, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; soluble and reverted phosphoric acid (available), 2 to 4 per cent.; nitrogen, 7 to 9 per cent.; ammonia, 9 to 11 per cent.

	Per cent.
Moisture at 100° C.	10.65
Total phosphoric acid,	7.30
Soluble phosphoric acid,	1.70
Reverted phosphoric acid,	2.93
Insoluble phosphoric acid,	3.77
Nitrogen,	8.23
Insoluble matter,	2.05

Valuation per two thousand pounds: —

34. pounds of soluble phosphoric acid,	$3 40
58.6 pounds of reverted phosphoric acid,	5 27
75.4 pounds of insoluble phosphoric acid,	3 39
164.6 pounds of nitrogen,	32 92
	$44 98

Dry Fish.

(Collected of H. L. Phelps, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; ammonia, 10 to 12 per cent. (equivalent to nitrogen, 8.24 to 10 per cent.).

	Per cent.
Moisture at 100° C.,	9.10
Total phosphoric acid,	9.08
Soluble phosphoric acid,	1.70
Reverted phosphoric acid,	2.14
Insoluble phosphoric acid,	5.24
Nitrogen,	8.42
Insoluble matter,	2.62

Valuation per two thousand pounds: —

34. pounds of soluble phosphoric acid,	$3 40
42.8 pounds of reverted phosphoric acid,	3 85
104.8 pounds of insoluble phosphoric acid,	4 72
168.4 pounds of nitrogen,	33 68
	$45 65

Phelps' Dry Fish.

(Collected of R. T. Prentiss, Holyoke, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; ammonia, 10 to 12 per cent. (equivalent to nitrogen, 8.23 to 9.9 per cent.).

	Per cent.
Moisture at 100° C.,	9.33
Total phosphoric acid,	6.75
Reverted phosphoric acid,	2.96
Insoluble phosphoric acid,	3.79
Nitrogen,	9.35
Insoluble matter,	2.5

Valuation per two thousand pounds: —

59.2 pounds of reverted phosphoric acid,	$5 33
75.8 pounds of insoluble phosphoric acid,	3 41
187. pounds of nitrogen,	37 40
	$46 14

Dry Ground Fish Guano.

(Stearns & Co., New York; collected of B. F. Bridges, South Deerfield, Mass.)

Guaranteed composition: Ammonia, 9 to 11 per cent. (equivalent to nitrogen, 7.4 to 9 per cent.); bone phosphate, 15 to 20 per cent. (equal to phosphoric acid, 6.8 to 9.2 per cent.).

	Per cent.
Moisture at 100° C.,	12.38
Total phosphoric acid,	7.99
Soluble phosphoric acid,	–
Reverted phosphoric acid,	1.78
Insoluble phosphoric acid,	6.21
Nitrogen,	7.57
Insoluble matter,	1.74

Valuation per two thousand pounds: —

35 6 pounds of reverted phosphoric acid,	$3 20
124.2 pounds of insoluble phosphoric acid,	5 59
151.4 pounds of nitrogen,	30 28
	$39 07

Bowker's Dry Fish.

(Collected of C. F. Brown, Northampton, Mass.)

Guaranteed composition: Ammonia, 10 to 12 per cent. (equivalent to nitrogen, 8.2 to 9.88 per cent.).

	Per cent.
Moisture at 100° C.,	10.35
Total phosphoric acid,	7.13
Reverted phosphoric acid,	2.14
Insoluble phosphoric acid,	4.99
Nitrogen,	8.03
Insoluble matter,	4.99

Valuation per two thousand pounds: —

42.8 pounds of reverted phosphoric acid,	$3 85
99.8 pounds of insoluble phosphoric acid,	4 49
160.6 pounds of nitrogen,	32 12
	$40 46

Chittenden's Dry Fish.

(National Fertilizer Co., Bridgeport, Conn.; collected of J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; ammonia, 8 to 10 per cent. (equivalent to nitrogen, 6.6 to 8.2 per cent.).

	Per cent.
Moisture at 100° C.,	12.70
Total phosphoric acid,	8.43
Soluble phosphoric acid, Reverted phosphoric acid,	2.63
Insoluble phosphoric acid,	5.80
Nitrogen,	7.53
Insoluble matter,	4.40

Valuation per two thousand pounds: —

52.6	pounds of soluble and reverted phosphoric acid,	$4 73
116.	pounds of insoluble phosphoric acid,	5 22
150.6	pounds of nitrogen,	30 12
		$40 07

Stearns & Co's "No. 1 Eagle Brand" Fish and Potash.

(Collected of B. F. Bridges, South Deerfield, Mass.)

Guaranteed composition: Moisture, 12 to 15 per cent.; nitrogen from fish, 2½ to 4½ per cent. (equivalent to ammonia, 3 to 5 per cent.); available phosphoric acid from bone phosphate, 3 to 5 per cent.; insoluble phosphoric acid, 3 to 5 per cent.; potassium oxide, 4 to 6 per cent.

	Per cent.
Moisture at 100° C.,	14.83
Total phosphoric acid,	7.49
Soluble phosphoric acid,	1.89
Reverted phosphoric acid,	2.61
Insoluble phosphoric acid,	2.99
Potassium oxide,	4.64
Nitrogen,	3.46
Insoluble matter,	2.75

Valuation per two thousand pounds: —

37.8 pounds of soluble phosphoric acid,	$3 78
52.2 pounds of reverted phosphoric acid,	4 70
59.8 pounds of insoluble phosphoric acid,	2 69
92.8 pounds of potassium oxide,	3 94
69.2 pounds of nitrogen,	13 84
	$28 95

Church's Fish and Potash.

(Collected of John B. Moore & Son, Concord, Mass.)

No guaranty reported.

	Per cent.
Moisture at 100° C.,	23.73
Total phosphoric acid,	5.92
Soluble phosphoric acid,	2.21
Reverted phosphoric acid,	2.13
Insoluble phosphoric acid,	1.58
Potassium oxide,	2.56
Nitrogen,	4.94
Insoluble matter,	1.35

Valuation per two thousand pounds: —

44.2 pounds of soluble phosphoric acid,	$4 42
42.6 pounds of reverted phosphoric acid,	3 83
31.6 pounds of insoluble phosphoric acid,	1 42
51.2 pounds of potassium oxide,	2 18
98.8 pounds of nitrogen,	19 76
	$31 61

Miles' Fish and Potash (XX).

(Collected of D. J. Wright, Northampton Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid (available), 5 to 8 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3.30 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	19 50
Total phosphoric acid,	9.74
Soluble phosphoric acid,	4.86
Reverted phosphoric acid,	.04
Insoluble phosphoric acid,	4.84
Potassium oxide,	3.05
Nitrogen,	3.40
Insoluble matter,	3.95

Valuation per two thousand pounds: —

97.2 pounds of soluble phosphoric acid,	$9 72
.8 pound of reverted phosphoric acid,	07
96.8 pounds of insoluble phosphoric acid,	4 36
61. pounds of potassium oxide,	2 59
68. pounds of nitrogen,	13 60
	$30 34

Fish and Potash.

(Quinnipiac Fertilizer Co., New Haven, Conn; collected of Robinson & Brooks, Palmer, Mass.)

Guaranteed composition: Nitrogen, $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent. (equivalent to ammonia, 4 to 5 per cent.); soluble and reverted phosphoric acid (available), 3 to 5 per cent.; total phosphoric acid, 5 to 7 per cent.; potassium oxide, 3 to 5 per cent.

	Per cent.
Moisture at 100° C.,	26.43
Nitrogen,	4.26
Total phosphoric acid,	7.31
Soluble phosphoric acid, Reverted phosphoric acid,	3.13

	Per cent.
Insoluble phosphoric acid,	4.18
Potassium oxide,	4.16
Insoluble matter,	2.32

Valuation per two thousand pounds: —

62.6 pounds of available phosphoric acid,	$5 63
83.6 pounds of insoluble phosphoric acid,	3 76
83.2 pounds of potassium oxide,	3 54
85.2 pounds of nitrogen,	17 04
	$29 97

Quinnipiac Fish and Potash.

(Collected of D. A. Horton, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid, 3 to 4 per cent.; nitrogen, 3½ to 4¼ per cent. (equivalent to ammonia, 4 to 5 per cent.); potassium oxide, 3 to 5 per cent.

	Per cent.
Moisture at 100° C.,	20.30
Total phosphoric acid,	8.12
Soluble phosphoric acid,	.96
Reverted phosphoric acid,	4.08
Insoluble phosphoric acid,	3.08
Nitrogen,	4.10
Potassium oxide,	4.78
Insoluble matter,	.56

Valuation per two thousand pounds: —

19.2 pounds of soluble phosphoric acid,	$1 92
81.6 pounds of reverted phosphoric acid,	7 34
61.6 pounds of insoluble phosphoric acid,	2 77
82. pounds of nitrogen,	16 40
95.6 pounds of potassium oxide,	4 06
	$32 49

Chittenden's Fish and Potash.

(National Fertilizer Co., Bridgeport, Conn.; collected of J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 3 to 5 per cent. (equivalent to nitrogen, 2.5 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	12.57
Total phosphoric acid,	8.11
Soluble phosphoric acid,	1.54
Reverted phosphoric acid,	1.91
Insoluble phosphoric acid,	4.66
Potassium oxide,	6.05
Nitrogen,	3.61
Insoluble matter,	2.00

Valuation per two thousand pounds: —

30.8 pounds of soluble phosphoric acid,	$3 08
38.2 pounds of reverted phosphoric acid,	3 44
93.2 pounds of insoluble phosphoric acid,	4 19
121. pounds of potassium oxide,	5 14
72.2 pounds of nitrogen,	14 44
	$30 29

Bowker's Fish and Potash.

(Collected of C. F. Brown, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 6 per cent.; nitrogen, 2½ to 3½ per cent. (equivalent to ammonia, 3 to 4¼ per cent.).

	Per cent.
Moisture at 100° C.,	10.65
Total phosphoric acid,	10.78
Reverted phosphoric acid,	1.52
Soluble phosphoric acid,	2.24
Insoluble phosphoric acid,	7.02
Nitrogen,	2.07
Potassium oxide,	3.73
Insoluble matter,	7.20

Valuation per two thousand pounds: —

30.4 pounds of reverted phosphoric acid,	$2 74
44.8 pounds of soluble phosphoric acid,	4 48
140.4 pounds of insoluble phosphoric acid,	6 32
41.4 pounds of nitrogen,	8 28
74.6 pounds of potassium oxide,	3 17
	$24 99

Fine Ground Bones.

(Bowker Fertilizer Company, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 20 to 23 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	10.00
Total phosphoric acid,	22.74
Reverted phosphoric acid,	3.97
Insoluble phosphoric acid,	18.77
Nitrogen,	3.85

Valuation per two thousand pounds: —

79.4 pounds of reverted phosphoric acid,	$8 05
375.4 pounds of insoluble phosphoric acid,	16 89
77. pounds of nitrogen,	13 86
	$38 80

Fine Bones.

(From Lee, Blackburn & Co., Lawrence, Mass.)

	Per cent.
Moisture at 100° C.,	4.80
Total phosphoric acid,	26.06
Reverted and soluble phosphoric acid,	2.75
Insoluble phosphoric acid,	23.31
Nitrogen,	2.99
Insoluble matter,	2.93

Valuation per two thousand pounds: —

55. pounds of available phosphoric acid,	$4 95
466.2 pounds of insoluble phosphoric acid,	20 98
59.8 pounds of nitrogen,	10 76
	$36 69

Darling's Fine Bone.

(Collected of Parker & Gannett, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 25 per cent.; nitrogen, 3 to 4 per cent.

	Per cent.
Moisture at 100° C.,	4.70
Total phosphoric acid,	26.62
Reverted phosphoric acid,	6.77
Insoluble phosphoric acid,	19.85
Nitrogen,	3.56
Insoluble matter,	.62

Valuation per two thousand pounds: —

135.4 pounds of reverted phosphoric acid,	$12 19
397. pounds of insoluble phosphoric acid,	17 87
71.2 pounds of nitrogen,	12 82
	$42 88

Lobos' Peruvian Guano.

(Collected of Chas. A. Ropes & Son, Salem, Mass., by J. B. Lindsey, assistant of Inspector.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	12.45
Total phosphoric acid,	15 45
Soluble phosphoric acid,	.35
Reverted phosphoric acid,	4.83
Insoluble phosphoric acid,	10 27
Potassium oxide,	2.12
Nitrogen (in ammonia salts),	3.38
Nitrogen (in organic matter),	1.36
Nitrogen (in nitrates),	.51
Insoluble matter,	11.55

Valuation per two thousand pounds: —

7. pounds of soluble phosphoric acid,	$0 70
96.6 pounds of reverted phosphoric acid,	8 69
205.4 pounds of insoluble phosphoric acid,	9 24
42.4 pounds of potassium oxide,	1 80
67.6 pounds of nitrogen (in ammonia salts),	14 87
27.2 pounds of nitrogen (in organic matter),	5 44
10.2 pounds of nitrogen (in nitrates),	1 84
	$42 58

Lobos' Peruvian Guano, No. 1.

(Collected of D. A. Horton, Northampton, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	14.20
Total phosphoric acid,	21.69
Soluble phosphoric acid,	2.81
Reverted phosphoric acid,	6.20
Insoluble phosphoric acid,	12.68
Nitrogen (in organic matter),	2.30
Nitrogen (in ammonia salts),	3.48
Nitrogen (in nitrates),	.40
Potassium oxide,	–
Insoluble matter,	4.60

Valuation per two thousand pounds: —

56 2 pounds of soluble phosphoric acid,	$5 62
124. pounds of reverted phosphoric acid,	11 16
253.6 pounds of insoluble phosphoric acid,	11 41
46. pounds of nitrogen (in organic matter)	9 20
69.6 pounds of nitrogen (in ammonia salts),	15 31
8. pounds of nitrogen (in nitrates),	1 44
	$54 14

Chittenden's Complete Fertilizer (Seeding Down, and Pastures)

(Collected of J. A. Sullivan, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 9 to 11 per cent.; soluble phosphoric acid, 3 to 4 per cent.; available phosphoric acid, 4 to 6 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); potassium chloride, 5 to 7 per cent. (equal to from 3.16 to 4.42 per cent. of potassium oxide).

	Per cent.
Moisture at 100° C.,	15.70
Total phosphoric acid,	7.88
Soluble phosphoric acid,	4.03
Reverted phosphoric acid,	1.72
Insoluble phosphoric acid,	2.13
Potassium oxide,	3.50
Nitrogen,	2.54
Insoluble matter,	3.80

Valuation per two thousand pounds:—

80.6 pounds of soluble phosphoric acid,	$8 06
34.4 pounds of reverted phosphoric acid,	3 10
42.6 pounds of insoluble phosphoric acid,	1 92
70. pounds of potassium oxide,	2 97
50.8 pounds of nitrogen,	10 16
	$26 21

Soluble Pacific Guano.

(Glidden & Curtis, Boston, Mass.; collected of J. A. Wright, Northampton, Mass.)

Guaranteed composition: Moisture, 10 to 12 per cent.; soluble phosphoric acid, 6.5 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; available phosphoric acid, 8 to 10 per cent.; insoluble phosphoric acid, 3 to 4 per cent.; nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2.5 to 3.5 per cent.); potassium oxide, 2 to 3½ per cent.

	Per cent.
Moisture at 100° C.,	15.08
Total phosphoric acid,	11.46
Soluble phosphoric acid,	5.76
Reverted phosphoric acid,	1.51
Insoluble phosphoric acid,	4.19
Potassium oxide,	2.20
Nitrogen (in organic matter),	1.81
Nitrogen (in ammonia salts),	.37
Nitrogen (in nitrates),	.61
Insoluble matter,	3.08

Valuation per two thousand pounds: —

115.2 pounds of soluble phosphoric acid,	$11 52
30.2 pounds of reverted phosphoric acid,	2 72
83.8 pounds of insoluble phosphoric acid,	3 77
44. pounds of potassium oxide,	1 87
36.2 pounds of nitrogen (in organic matter),	7 24
7.4 pounds of nitrogen (in ammonia salts),	1 63
12.2 pounds of nitrogen (in nitrates),	2 20
	$30 95

Stockbridge Manures (Potato).

(Bowker Fertilizer Co., Boston, Mass.; collected of R. T. Prentiss, Holyoke, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid, 7 to 8 per cent.; potassium oxide, 5 to 6 per cent.; nitrogen, $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent.

	Per cent.
Moisture at 100° C.,	17.60
Total phosphoric acid,	11.19
Soluble phosphoric acid,	7.23
Reverted phosphoric acid,	1.48
Insoluble phosphoric acid,	2.48
Nitrogen,	3.96
Potassium oxide,	4.29
Insoluble matter,	4.40

Valuation per two thousand pounds: —

144.6 pounds of soluble phosphoric acid,	$14 46
29.6 pounds of reverted phosphoric acid,	2 66
49.6 pounds of insoluble phosphoric acid,	2 23
79.2 pounds of nitrogen,	15 84
85.8 pounds of potassium oxide,	3 65
	$38 84

Crocker's Ammoniated Bone Superphosphate.

(Collected of R. T. Prentiss, Holyoke, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 1 to 3 per cent.; $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent. of nitrogen.

	Per cent.
Moisture at 100° C.,	12.18
Total phosphoric acid,	11.98
Soluble phosphoric acid,	6.65
Reverted phosphoric acid,	1.87

	Per cent.
Insoluble phosphoric acid,	3.46
Potassium oxide,	.95
Nitrogen (in organic matter),	2.56
Nitrogen (in ammonia salts),	.87
Insoluble matter,	4.85

Valuation per two thousand pounds: —

133.	pounds of soluble phosphoric acid,	$13 30
37.4	pounds of reverted phosphoric acid,	3 37
69.2	pounds of insoluble phosphoric acid,	3 11
19.	pounds of potassium oxide,	81
51.2	pounds of nitrogen (in organic matter),	10 24
17.40	pounds of nitrogen (in ammonia salts),	3 83
		$34 66

Lister's Celebrated Corn Manure.

(Collected of D. J. Wright, Northampton, Mass.)

Guaranteed composition: Available phosphoric acid, 9 to 10 per cent.; potassium oxide, 7 to 8 per cent.; ammonia, 4½ to 5 per cent. (equivalent to nitrogen, 3.7 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	12.95
Total phosphoric acid,	9.53
Soluble phosphoric acid,	8.64
Reverted phosphoric acid,	.40
Insoluble phosphoric acid,	.49
Potassium oxide,	7.07
Nitrogen (in ammonia salts),	3.24
Nitrogen (in organic matter),	.91

Valuation per two thousand pounds: —

172.8	pounds of soluble phosphoric acid,	$17 28
8.	pounds of reverted phosphoric acid,	72
9.8	pounds of insoluble phosphoric acid,	44
141.4	pounds of potassium oxide,	6 01
18.2	pounds of nitrogen (in organic matter),	3 64
64.8	pounds of nitrogen (in ammonia salts),	14 26
		$42 35

Complete Manure (Grass).

(Collected of H. L. Phelps, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 7 to 8 per cent.; soluble and reverted phosphoric acid (available), 4 to 6 per cent. ; potash, 6 to 8 per cent. ; ammonia, 5 to 7 per cent. (equivalent to nitrogen, 4.1 to 5.76 per cent.).

	Per cent.
Moisture at 100° C.,	4.96
Total phosphoric acid,	9.39
Soluble phosphoric acid,	4.26
Reverted phosphoric acid,	.85
Insoluble phosphoric acid,	4.28
Potassium oxide,	5.94
Nitrogen (in organic matter),	2.84
Nitrogen (in ammonia salts),	2.88
Nitrogen (in nitrates),	1.64

Valuation per two thousand pounds: —

85.2 pounds of soluble phosphoric acid,	$8 52
17. pounds of reverted phosphoric acid,	1 53
85.6 pounds of insoluble phosphoric acid,	3 85
118.8 pounds of potassium oxide,	5 05
56 8 pounds of nitrogen (in organic matter),	11 36
57.6 pounds of nitrogen (in ammonia salts),	12 67
32.8 pounds of nitrogen (in nitrates),	5 90
	$48 88

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of Puffer & Wilder, Springfield, Mass.)

Guaranteed composition: Nitrogen, 2½ to 3½ per cent. (equivalent to ammonia, 3 to 4 per cent.) ; soluble phosphoric acid, 7 to 8 per cent. ; reverted phosphoric acid, 2 to 3 per cent. ; insoluble phosphoric acid, 2 to 3 per cent. ; total phosphoric acid, 11 to 14 per cent. ; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	15.60
Total phosphoric acid,	12.57
Soluble phosphoric acid,	7.19
Reverted phosphoric acid,	3.42
Insoluble phosphoric acid,	1.96
Nitrogen (in organic matter),	2.88
Nitrogen (in nitrates),	.37
Potassium oxide,	2.40
Insoluble matter,	4.86

Valuation per two thousand pounds: —

143.8 pounds of soluble phosphoric acid,	$14 38
68.4 pounds of reverted phosphoric acid,	6 16
39.2 pounds of insoluble phosphoric acid,	1 76

57.6 pounds of nitrogen (in organic matter),	$11 52
7.4 pounds of nitrogen (in nitrates),	1 33
48. pounds of potassium oxide,	2 04
	$37 19

Williams, Clark & Co.'s "Americus" Ammoniated Bone Superphosphate.

(Collected of B. L. Bragg & Co. Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 13 per cent.; soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 1 to 2 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.6 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	17.37
Total phosphoric acid,	11.79
Soluble phosphoric acid,	6.62
Reverted phosphoric acid,	3.00
Insoluble phosphoric acid,	2.17
Potassium oxide,	1.85
Nitrogen (in organic matter),	2.73
Nitrogen (in nitrates),	.23

Valuation per two thousand pounds: —

132.4 pounds of soluble phosphoric acid,	$13 24
60. pounds of reverted phosphoric acid,	5 40
43.4 pounds of insoluble phosphoric acid,	1 95
37. pounds of potassium oxide,	1 57
54.6 pounds of nitrogen (in organic matter),	10 92
4.6 pounds of nitrogen (in nitrates),	83
	$33 91

E. Frank Coe's Ammoniated Bone Superphosphate.

(Collected of C. J. Othick, Feeding Hills, Mass.)

Guaranteed composition: Soluble phosphoric acid, 9 to 12 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; ammonia, 2½ to 3 per cent. (equivalent to nitrogen, 2 to 2.47 per cent.).

	Per cent.
Moisture at 100° C.,	12.76
Total phosphoric acid,	11.60
Soluble phosphoric acid,	4.51
Reverted phosphoric acid,	2.91
Insoluble phosphoric acid,	4.18
Potassium oxide,	1.18
Nitrogen (in organic matter),	2.14
Insoluble matter,	5.78

Valuation per two thousand pounds. : —

90.2 pounds of soluble phosphoric acid,	$9 02
58.2 pounds of reverted phosphoric acid,	5 24
83.6 pounds of insoluble phosphoric acid,	3 76
23 6 pounds of potassium oxide,	1 00
42.8 pounds of nitrogen (in organic matter),	8 56
	$27 58

Quinnipiac Co.'s Extra Superphosphate.

(Collected of B. L. Bragg & Co., Springfield, Mass.)

Guaranteed composition: Nitrogen $1\frac{3}{4}$ to $2\frac{1}{2}$ per cent. (equivalent to ammonia, 2 to 3 per cent.) ; total phosphoric acid, 10 to 12 per cent. ; soluble phosphoric acid, 6 to 8 per cent., available phosphoric acid, 8 to 10 per cent. ; sulphate of potash, 2 to 4 per cent. (potassium oxide, 1.2 to 2.4 per cent.).

	Per cent.
Moisture at 100° C.,	19.88
Total phosphoric acid,	11 61
Soluble phosphoric acid,	3.87
Reverted phosphoric acid,	4 42
Insoluble phosphoric acid,	3.32
Potassium oxide,	2.06
Nitrogen (in ammonia salts),	.81
Nitrogen (in organic matter),	2.33
Insoluble matter,	6.98

Valuation per two thousand pounds : —

77.4 pounds of soluble phosphoric acid,	$7 74
88.4 pounds of reverted phosphoric acid,	7 96
66.4 pounds of insoluble phosphoric acid,	2 99
41.2 pounds of potassium oxide,	1 75
46.6 pounds of nitrogen (in organic matter),	9 32
16.2 pounds of nitrogen (in ammonia salts),	3 56
	$33 32

Chittenden's Complete Fertilizer (Corn).

(Collected of Puffer & Wilder, Springfield, Mass.)

Guaranteed composition: Ammonia, $4\frac{1}{2}$ to $5\frac{1}{2}$ per cent. (equivalent to nitrogen, 3.7 to 4.53 per cent.) ; total phosphoric acid, 8 to 10 per cent. ; soluble and reverted phosphoric acid (available), 6 to 8 per cent. ; potassium oxide, 5 to 7 per cent.

	Per cent.
Moisture at 100° C.,	15.20
Total phosphoric acid,	8.82
Soluble phosphoric acid,	4.48
Reverted phosphoric acid,	1.44
Insoluble phosphoric acid,	2.90
Potassium oxide,	6.55
Nitrogen,	4.10
Insoluble matter,	2.95

Valuation per two thousand pounds: —

89.6 pounds of soluble phosphoric acid,	$8 96
28.8 pounds of reverted phosphoric acid,	2 59
58. pounds of insoluble phosphoric acid,	2 61
131. pounds of potassium oxide,	5 57
82. pounds of nitrogen,	16 40
	$36 13

H. J. Baker & Bros. Grass and Lawn Dresser.

(Collected of Robinson & Brooks, Palmer, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	17.40
Total phosphoric acid,	8.11
Soluble phosphoric acid,	6.65
Reverted phosphoric acid,	.72
Insoluble phosphoric acid,	.74
Potassium oxide,	5.87
Nitrogen (in organic matter),	2.47
Nitrogen (in ammonia salts),	1.68
Nitrogen (in nitrates),	.34
Insoluble matter,	2.02

Valuation per two thousand pounds: —

13.3 pounds of soluble phosphoric acid,	$13 30
14.4 pounds of reverted phosphoric acid,	1 30
14.8 pounds of insoluble phosphoric acid,	67
117.4 pounds of potassium oxide,	4 99
49.4 pounds of nitrogen (in organic matter),	9 88
33.6 pounds of nitrogen (in ammonia salts),	7 39
6.8 pounds of nitrogen (in nitrates),	1 22
	$38 75

L. B. Darling's Animal Fertilizer.

(Collected of Parker & Gannett, Boston, Mass.)

Guaranteed composition: Nitrogen, 4 to 6 per cent.; phosphoric acid, 10 to 12 per cent.; potassium oxide, 5 to 6 per cent.

	Per cent.
Moisture at 100° C.,	13.46
Total phosphoric acid,	13.96
Soluble phosphoric acid,	.58
Reverted phosphoric acid,	2.44
Insoluble phosphoric acid,	10.94
Potassium oxide,	4.39
Nitrogen (in organic matter),	2.14
Nitrogen (in ammonia salts),	.64
Nitrogen (in nitrates),	.28
Insoluble matter,	5.23

Valuation per two thousand pounds: —

11.6 pounds of soluble phosphoric acid,.	$1 16
48.8 pounds of reverted phosphoric acid,	4 39
218.8 pounds of insoluble phosphoric acid,	9 85
87.8 pounds of potassium oxide,	3 73
42.8 pounds of nitrogen (in organic matter),	8 56
12.8 pounds of nitrogen (in ammonia salts),	2 82
5.6 pounds of nitrogen (in nitrates),	1 01
	$31 52

Quinnipiac Co's Phosphate.

(Collected of Robinson & Brooks, Palmer, Mass.)

Guaranteed composition: Nitrogen, 2⅓ to 3½ per cent. (equivalent to ammonia, 3 to 4 per cent.); insoluble phosphoric acid, 1 to 3 per cent.; soluble and reverted phosphoric acid (available), 8 to 10 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	17.57
Total phosphoric acid,	9.66
Soluble phosphoric acid,	6.97
Reverted phosphoric acid,	.76
Insoluble phosphoric acid,	1.93
Nitrogen,	3.18
Potassium oxide,	2.47

Valuation per two thousand pounds: —

139.4 pounds of soluble phosphoric acid,	$13 94
15.2 pounds of reverted phosphoric acid,	1 37
38.6 pounds of insoluble phosphoric acid,	1 74
63.6 pounds of nitrogen,.	12 72
49.4 pounds of potassium oxide,	2 10
	$31 87

Bay State Ammoniated Bone Superphosphate.

(J. A. Tucker, Boston, Mass.; collected of Robinson & Brooks, Palmer, Mass.)

Guaranteed composition: Ammonia, 2½ to 3½ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.); soluble and reverted phosphoric acid (available), 8 to 11 per cent.; potassium oxide, 2 to 3½ per cent.

	Per cent.
Moisture at 100° C.,	19.78
Total phosphoric acid,	11.13
Soluble phosphoric acid,	7.54
Reverted phosphoric acid,	1.48
Insoluble phosphoric acid,	2.11
Nitrogen,	2.89
Potassium oxide,	3.22

Valuation per two thousand pounds: —

150.8 pounds of soluble phosphoric acid,	$15 08
29.6 pounds of reverted phosphoric acid,	2 66
42.2 pounds of insoluble phosphoric acid,	1 90
57.8 pounds of nitrogen,	11 56
64.4 pounds of potassium oxide,	2 74
	$33 94

Bowker's Animal Fertilizer.

(Collected of Breck & Son, Boston, Mass.)

Guaranteed composition: Ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); soluble phosphoric acid, 6 to 8 per cent.; available phosphoric acid, 10 to 12 per cent.; bone phosphate, 20 to 24 per cent.; muriate of potash, 4 to 6 per cent. (equivalent to 2 to 3 per cent. potassium oxide).

	Per cent.
Moisture at 100° C.,	17.47
Total phosphoric acid,	10.81
Soluble phosphoric acid,	4.36
Reverted phosphoric acid,	3.33
Insoluble phosphoric acid,	3.12
Potassium oxide,	4.15
Nitrogen,	2.44
Insoluble matter,	4.53

Valuation per two thousand pounds: —

87.2 pounds of soluble phosphoric acid,	$8 72
66.6 pounds of reverted phosphoric acid,	5 99
62.4 pounds of insoluble phosphoric acid,	2 81

83. pounds of potassium oxide,	$3 53
48.8 pounds of nitrogen,	9 76
	$30 81

Sparrow's Bone and Potash.

(Judson & Sparrow, Boston, Mass.; collected of Gleason & Everett, Boston, Mass.)

Guaranteed composition: Ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); soluble and reverted phosphoric acid (available), 8 to 9 per cent.; potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	13.65
Total phosphoric acid,	11.13
Soluble phosphoric acid,	8.64
Reverted phosphoric acid,	1.87
Insoluble phosphoric acid,	.62
Potassium oxide,	4.04
Nitrogen,	3.05

Valuation per two thousand pounds: —

172.8 pounds of soluble phosphoric acid,	$17 28
37.4 pounds of reverted phosphoric acid,	3 37
12.4 pounds of insoluble phosphoric acid,	56
80.8 pounds of potassium oxide,	3 43
61. pounds of nitrogen,	12 20
	$36 84

Standard Superphosphate.

(Standard Fertilizer Co., Boston, Mass.; collected of C. H. Thompson & Co., Boston, Mass.)

Guaranteed composition: Ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); available phosphoric acid, 9 to 13 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 4 per cent.

	Per cent.
Moisture at 100° C.,	12.19
Total phosphoric acid,	13.25
Soluble phosphoric acid,	5.67
Reverted phosphoric acid,	4.50
Insoluble phosphoric acid,	3.08
Nitrogen,	2.22
Potassium oxide,	2.58
Insoluble matter,	6.99

Valuation per two thousand pounds: —

113.4 pounds of soluble phosphoric acid,	$11 34
90. pounds of reverted phosphoric acid,	8 10
61.6 pounds of insoluble phosphoric acid,	2 77
44.4 pounds of nitrogen,	8 88
51.6 pounds of potassium oxide,	2 19
	$33 28

Sparrow's Grass Fertilizer.

(Judson & Sparrow, Boston, Mass.; collected of Everett & Gleason, Boston, Mass.)

Guaranteed composition: Ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4 to 5 per cent.); soluble and reverted phosphoric acid (available), 8 to 9 per cent.; potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	12.57
Total phosphoric acid,	10.46
Soluble phosphoric acid,	7.68
Reverted phosphoric acid,	2.10
Insoluble phosphoric acid,	.68
Potassium oxide,	4.52
Nitrogen (in ammonia salts),	3.15
Nitrogen (in organic matter),	1.56

Valuation per two thousand pounds: —

153.6 pounds of soluble phosphoric acid,	$15 36
42. pounds of reverted phosphoric acid,	3 78
13.6 pounds of insoluble phosphoric acid,	61
90.4 pounds of potassium oxide,	3 84
63. pounds of nitrogen (in ammonia salts),	13 86
31.2 pounds of nitrogen (in organic matter),	6 24
	$43 69

Pacific Island Phosphate.

(Pacific Guano Co., New York; collected at railroad depot, South Deerfield, Mass.)

Guaranteed composition: Ammonia, 1 to 2 per cent. (equivalent to nitrogen, .8 to 1.6 per cent.); bone phosphate, 26 to 30 per cent.; sulphate of potash, 12 to 15 per cent. (equal to potassium oxide, 6.49 to 8.12 per cent.)

	Per cent.
Moisture at 100° C.,	8.35
Total phosphoric acid,	12.47
Soluble phosphoric acid,	.61
Reverted phosphoric acid,	2.48
Insoluble phosphoric acid,	9.38

	Per cent.
Nitrogen (in organic matter),	.75
Potassium oxide,	6.64
Chlorine,	16.36
Sulphuric acid,	15.02
Insoluble matter,	.20

Valuation per two thousand pounds: —

12.2 pounds of soluble phosphoric acid,	$1 22
49.6 pounds of reverted phosphoric acid,	4 46
187.6 pounds of insoluble phosphoric acid,	8 44
15. pounds of nitrogen,	3 00
132.8 pounds of potassium oxide,	9 63
	$26 75

Standard Superphosphate.

(Standard Fertilizer Co., Boston, Mass.; collected of Slate & DeWolf, Greenfield, Mass.)

Guaranteed composition: Ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); available phosphoric acid, 9 to 13 per cent.; soluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 4 per cent.

	Per cent.
Moisture at 100° C.,	12.30
Total phosphoric acid,	12.69
Soluble phosphoric acid,	3.52
Reverted phosphoric acid,	4.51
Insoluble phosphoric acid,	4.66
Potassium oxide,	2.34
Nitrogen,	3.11

Valuation per two thousand pounds: —

70.4 pounds of soluble phosphoric acid,	$7 04
90.2 pounds of reverted phosphoric acid,	8 12
93.2 pounds of insoluble phosphoric acid,	4 19
46.8 pounds of potassium oxide,	1 99
62.2 pounds of nitrogen,	12 44
	$33 78

Bradley's Sea Fowl.

(Collected of Sheldon & Newcomb, Greenfield, Mass.)

Guaranteed composition: Nitrogen, 2½ to 3½ per cent. (equivalent to ammonia, 3 to 4 per cent.); soluble phosphoric acid, 7 to 8 per cent.; available phosphoric acid, 9 to 11 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	15.16
Total phosphoric acid,	10.95
Soluble phosphoric acid,	6.78
Reverted phosphoric acid,	1.70
Insoluble phosphoric acid,	2.47
Potassium oxide,	2.86
Nitrogen (in organic matter),	3.29
Insoluble matter,	5.70

Valuation per two thousand pounds: —

135.6 pounds of soluble phosphoric acid,	$13 56
34. pounds of reverted phosphoric acid,	3 06
49.4 pounds of insoluble phosphoric acid,	2 22
57.2 pounds of potassium oxide,	2 43
65.8 pounds of nitrogen,	13 16
	$34 43

L. L. Crocker's Potato and Hop Superphosphate.

(Collected of Slate & DeWolf, Greenfield, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; precipitated phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; ammonia, 2½ to 3½ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.); potassium oxide, 6 to 8 per cent.

	Per cent.
Moisture at 100° C.,	14 50
Total phosphoric acid,	9.54
Soluble phosphoric acid,	5.79
Reverted phosphoric acid,	1.22
Insoluble phosphoric acid	2.53
Potassium oxide,	4.81
Nitrogen,	3.35
Insoluble matter,	4.65

Valuation per two thousand pounds: —

115.8 pounds of soluble phosphoric acid,	$11 58
24.4 pounds of reverted phosphoric acid,	2 20
50.6 pounds of insoluble phosphoric acid,	2 28
96.2 pounds of potassium oxide,	4 09
67. pounds of nitrogen,	13 40
	$33 55

Stearns & Co.'s Ammoniated Bone Superphosphate.

(Collected of B. F. Bridges, Jr., So. Deerfield, Mass.)

Guaranteed composition: Moisture, 12 to 15 per cent.; nitrogen in organic matter, 2¾ to 3¼ per cent. (equivalent to ammonia, 3⅓ to 4⅓ per cent.); soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	13.20
Total phosphoric acid,	9.91
Soluble phosphoric acid,	5.24
Reverted phosphoric acid,	2.30
Insoluble phosphoric acid,	1.47
Potassium oxide,	2.25
Nitrogen,	3 35
Insoluble matter,	14.38

Valuation per two thousand pounds: —

104.8 pounds of soluble phosphoric acid,	$10 44
46. pounds of reverted phosphoric acid,	4 14
29.4 pounds of insoluble phosphoric acid,	1 32
45. pounds of potassium oxide,	1 91
67. pounds of nitrogen,	13 40
	$31 21

Miles' Ammoniated Bone Superphosphate.

(Collected of D. J. Wright, Northampton, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid, 8 to 12 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2¼ to 3¼ per cent.

	Per cent.
Moisture at 100° C.,	19.63
Total phosphoric acid,	11.87
Soluble phosphoric acid,	6.68
Reverted phosphoric acid,	1.14
Insoluble phosphoric acid,	4.05
Potassium oxide,	1.12
Nitrogen,	2.81
Insoluble matter,	5.55

Valuation per two thousand pounds: —

133.6 pounds of soluble phosphoric acid,	$13 36
22.8 pounds of reverted phosphoric acid,	2 05
81. pounds of insoluble phosphoric acid,	3 65

22.4 pounds of potassium oxide,	$0 95
56.2 pounds of nitrogen,	11 24
	$31 25

Glidden & Curtis' Soluble Pacific Guano.

(Collected of W. H. Earle, Worcester, Mass.)

Guaranteed composition: Moisture, 10 to 20 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; soluble phosphoric acid, 6½ to 8 per cent.; reverted phosphoric acid, 1½ to 3 per cent.; nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2½ to 3½ per cent.); potassium oxide, 2 to 3½ per cent.

	Per cent.
Moisture at 100° C.,	10.10
Total phosphoric acid,	13.43
Soluble phosphoric acid,	8.57
Reverted phosphoric acid,	.74
Insoluble phosphoric acid,	4.12
Nitrogen (in organic matter),	2.32
Nitrogen (in nitrates),	.47
Potassium oxide,	2 81
Insoluble matter,	6.76

Valuation per two thousand pounds: —

171.4 pounds of soluble phosphoric acid,	$17 14
14.8 pounds of reverted phosphoric acid,	1 33
82.4 pounds of insoluble phosphoric acid,	3 71
46.4 pounds of nitrogen (in organic matter),	9 28
9.4 pounds of nitrogen (in nitrates),	1 69
56.2 pounds of potassium oxide,	2 39
	$35 54

Dole's Common Sense Fertilizer, No. 2.

(Collected of E. H. Wood & Co., Lowell, Mass.)

Guaranteed composition: Nitrogen, 2 to 5 per cent.; phosphoric acid, 4 to 6 per cent.; potassium oxide, 3 to 5 per cent.

	Per cent.
Moisture at 100° C.,	11.55
Total phosphoric acid,	7.33
Soluble phosphoric acid,	.99
Reverted phosphoric acid,	2.60
Insoluble phosphoric acid,	3.75
Potassium oxide,	3.51
Nitrogen,	3.14
Insoluble matter,	15.25

Valuation per two thousand pounds:—

19.8 pounds of soluble phosphoric acid,	$1 98
52. pounds of reverted phosphoric acid,	4 68
75. pounds of insoluble phosphoric acid,	3 38
70.2 pounds of potassium oxide,	2 98
62.8 pounds of nitrogen,	12 56
	$25 58

Randall's Field and Farm Fertilizer.

(Boston Fertilizer Co., Boston, Mass.; collected of W. E. Livingston.)

Guaranteed composition: Total phosphoric acid, 10 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 1 to 2 per cent.; nitrogen, 2 to 2.9 per cent. (equivalent to ammonia, 2½ to 3½ per cent.); potassium oxide, 2 to 3 per cent.; moisture, 10 to 14 per cent.

	Per cent.
Moisture at 100° C.,	27.20
Total phosphoric acid,	8.37
Soluble phosphoric acid,	4.94
Reverted phosphoric acid,	3.30
Insoluble phosphoric acid,	2.13
Potassium oxide,	.90
Nitrogen (in organic matter),	2.09
Nitrogen (in ammonia salts)	.33
Insoluble matter,	.40

Valuation per two thousand pounds:—

98.8 pounds of soluble phosphoric acid,	$9 88
66. pounds of reverted phosphoric acid,	5 94
42.6 pounds of insoluble phosphoric acid,	1 92
18. pounds of potassium oxide,	76
41.8 pounds of nitrogen (in organic matter),	8 36
6.6 pounds of nitrogen (in ammonia salts),	1 45
	$28 31

Ames Raw Bone Superphosphate.

(Collected by Chas. H. Preston, Assistant of Inspector.)

Guaranteed composition: Total phosphoric acid, 13 to 15 per cent.; soluble phosphoric acid, 9 to 11 per cent.; reverted phosphoric acid, 2 to 3 per cent.; ammonia, 3½ to 4½ per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C.,	13.38
Total phosphoric acid,	14.37
Soluble phosphoric acid,	4.99
Reverted phosphoric acid,	7.26
Insoluble phosphoric acid,	2.12
Potassium oxide,	1.04
Nitrogen,	3.30
Insoluble matter,	1.10

Valuation per two thousand pounds: —

99.8 pounds of soluble phosphoric acid,	$9 98
145.2 pounds of reverted phosphoric acid,	13 07
42.4 pounds of insoluble phosphoric acid,	1 91
20.8 pounds of potassium oxide,	88
66. pounds of nitrogen,	13 20
	$39 04

Tobacco Fertilizer.

(B. Randall, Boston, Mass.; collected of H. C. Haskell, Deerfield, Mass.)

Guaranteed composition: Moisture, 10 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 1 to 2 per cent.; insoluble phosphoric acid, 4 to 5 per cent.; ammonia, 3½ to 4½ per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.); potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	12.50
Total phosphoric acid,	11.08
Soluble phosphoric acid;	9.21
Reverted phosphoric acid,	.57
Insoluble phosphoric acid,	1.30
Potassium oxide,	2.78
Nitrogen (in ammonia salts),	.22
Nitrogen (in nitrates),	.44
Nitrogen (in organic matter),	2.83
Insoluble matter,	.90

Valuation per two thousand pounds: —

184.2 pounds of soluble phosphoric acid,	$18 42
11.4 pounds of reverted phosphoric acid,	1 03
26. pounds of insoluble phosphoric acid,	1 17
4.4 pounds of nitrogen (in ammonia salts),	97

8.8 pounds of nitrogen (in nitrates),	$1 58
56.6 pounds of nitrogen (in organic matter),	11 32
55.6 pounds of potassium oxide,	2 36
	$36 85

Superphosphate of Lime.

(Bosworth Bros., Putnam, Conn.; collected of Wilson & Holden, Worcester, Mass.)

Guaranteed composition: Nitrogen 2 to 2½ per cent.; soluble phosphoric acid, 4 to 5 per cent.; reverted phosphoric acid, 3 to 5 per cent,; insoluble phosphoric acid, 7 to 9 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	14.75
Total phosphoric acid,	13.80
Soluble phosphoric acid,	3.45
Reverted phosphoric acid,	4.96
Insoluble phosphoric acid,	5.39
Potassium oxide,	2.10
Nitrogen,	2.54
Insoluble matter,	.80

Valuation per two thousand pounds: —

69. pounds of soluble phosphoric acid,	$6 90
99.2 pounds of reverted phosphoric acid,	8 93
107.8 pounds of insoluble phosphoric acid,	4 85
42. pounds of potassium oxide,	1 78
50.8 pounds of nitrogen,	10 16
	$32 62

Mapes' Corn Manure.

(Collected of W. H. Earle & Co., Worcester, Mass.)

Guaranteed composition: Ammonia, 4.5 to 5 per cent. (equivalent to nitrogen, 3.7 to 4 per cent.); phosphoric acid, 10 to 12 per cent.; potassium oxide, 6 to 7 per cent.; magnesium, calcium, soda, sulphuric acid, etc., 70 to 80 per cent.

	Per cent.
Moisture at 100° C.,	13.21
Total phosphoric acid,	12.86
Soluble phosphoric acid,	7.06
Reverted phosphoric acid,	2.33
Insoluble phosphoric acid,	3.87
Potassium oxide,	6.76
Nitrogen (in organic matter),	1.53

	Per cent
Nitrogen (in ammonia salts),	2.04
Nitrogen (in nitrates),	.86
Insoluble matter,	.90

Valuation per two thousand pounds: —

141.2 pounds of soluble phosphoric acid,	$14 12
46.6 pounds of reverted phosphoric acid,	4 19
77.4 pounds of insoluble phosphoric acid,	3 48
135.2 pounds of potassium oxide,	5 75
30.6 pounds of nitrogen (in organic matter),	6 12
40 8 pounds of nitrogen (in ammonia salts),	8 98
17.2 pounds of nitrogen (in nitrates),	3 10
	$45 74

Bay State Bone Superphosphate.

(J. A. Tucker & Co., Boston, Mass.; collected of Clark & Son, Worcester, Mass.)

Guaranteed composition: Soluble phosphoric acid, 9.2 per cent.; insoluble phosphoric acid, 3 per cent.; nitrogen, 2.71 per cent. (equivalent to ammonia, 3.29 per cent.).

	Per cent.
Moisture at 100° C.,	22 28
Total phosphoric acid,	10.30
Soluble phosphoric acid,	8.51
Reverted phosphoric acid,	.52
Insoluble phosphoric acid,	1.27
Potassium oxide,	1.57
Nitrogen,	1.59
Insoluble matter,	.60

Valuation per two thousand pounds: —

170.2 pounds of soluble phosphoric acid,	$17 02
10.4 pounds of reverted phosphoric acid,	94
25.4 pounds of insoluble phosphoric acid,	1 14
31.4 pounds of potassium oxide,	1 33
31.8 pounds of nitrogen,	6 36
	$26 79

Stearns' Ammoniated Bone Superphosphate.

(Collected of Wilson & Holden, Worcester, Mass.)

Guaranteed composition: Moisture, 12 to 15 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); soluble phosphoric acid, 8 to 11 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to sulphate of potash, 4 to 6 per cent.).

	Per cent.
Moisture at 100° C.,	12.40
Total phosphoric acid,	11.08
Soluble phosphoric acid,	5.66
Reverted phosphoric acid,	2.79
Insoluble phosphoric acid,	2.63
Potassium oxide,	2.93
Nitrogen,	2.49
Insoluble matter,	4.63

Valuation per two thousand pounds: —

113.2 pounds of soluble phosphoric acid,	$11 32
55.8 pounds of reverted phosphoric acid,	5 02
52.6 pounds of insoluble phosphoric acid,	2 37
58.6 pounds of potassium oxide,	4 25
49.8 pounds of nitrogen,	9 96
	$32 92

Bradley's XL Superphosphate of Lime.

(Collected of J. & J. A. Rice, Worcester, Mass.)

Guaranteed composition: Nitrogen, 2½ to 3½ per cent.; total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	15.09
Total phosphoric acid,	13.38
Soluble phosphoric acid,	8.85
Reverted phosphoric acid,	2.73
Insoluble phosphoric acid,	1.80
Nitrogen (in organic matter),	2.08
Nitrogen (in ammonia salts),	.51
Potassium oxide,	1.89
Insoluble matter,	5.24

Valuation per two thousand pounds: —

177. pounds of soluble phosphoric acid,	$17 70
54.6 pounds of reverted phosphoric acid,	4 91
36. pounds of insoluble phosphoric acid,	1 62

41.6 pounds of nitrogen (in organic matter),	$8 32
10.2 pounds of nitrogen (in ammonia salts),	2 24
37.8 pounds of potassium oxide,	1 61
	$36 40

Pacific Island Phosphate.

(Collected of H. C. Haskell, Deerfield, Mass.)

Guaranteed composition: Ammonia, 1 to 2 per cent. (equivalent to nitrogen, .8 to 1.6 per cent.); bone phosphate, 26 to 30 per cent.; sulphate of potash, 12 to 15 per cent.

	Per cent.
Moisture at 100° C.,	14.87
Total phosphoric acid,	11.21
Soluble phosphoric acid,	.24
Reverted phosphoric acid,	4.09
Insoluble phosphoric acid,	6.88
Potassium oxide,	6.07
Nitrogen,	.73
Sulphuric acid,	16.53
Insoluble matter,	.27

Valuation per two thousand pounds: —

4.8 pounds of soluble phosphoric acid,	$0 48
81.8 pounds of reverted phosphoric acid,	7 36
137.6 pounds of insoluble phosphoric acid,	6 19
121.4 pounds of potassium oxide,	8 80
14.6 pounds of nitrogen,	2 92
	$25 75

E. Frank Coe's Bone Superphosphate of Lime.

(Collected of Clark & Son, Worcester, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid (available), 11.96 per cent.; insoluble phosphoric acid, 1 to 2.8 per cent.; nitrogen, 2.64 per cent. (equivalent to ammonia, 3.2 per cent.).

	Per cent.
Moisture at 100° C.,	23 33
Total phosphoric acid,	11.04
Soluble phosphoric acid,	8.35
Reverted phosphoric acid,	1.87
Insoluble phosphoric acid,	.82
Potassium oxide,	1.63
Nitrogen,	2.68
Insoluble matter,	.68

Valuation per two thousand pounds: —

167. pounds of soluble phosphoric acid,	$16 70
37.4 pounds of reverted phosphoric acid,	3 37
16.4 pounds of insoluble phosphoric acid,	74
32.6 pounds of potassium oxide,	1 39
53.6 pounds of nitrogen,	10 72
	$32 92

Bowker's Hill and Drill Phosphate.

(Collected of W. H. Earle & Co., Worcester, Mass.)

Guaranteed composition: Ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.6 to 2.5 per cent.); total phosphoric acid, 10 to 12 per cent.; soluble and reverted phosphoric acid (available), 8 to 10 per cent.; potassium oxide, 2 to 3 per cent., in sulphate of potash.

	Per cent.
Moisture at 100° C.,	14.06
Total phosphoric acid,	11.74
Soluble phosphoric acid,	5.24
Reverted phosphoric acid,	2.89
Insoluble phosphoric acid,	3.61
Potassium oxide,	2.08
Nitrogen,	3.04
Insoluble matter,	3.28

Valuation per two thousand pounds: —

104.8 pounds of soluble phosphoric acid,	$10 48
57.8 pounds of reverted phosphoric acid,	4 05
72.2 pounds of insoluble phosphoric acid,	3 25
41.6 pounds of potassium oxide,	3 02
60.8 pounds of nitrogen,	12 16
	$32 96

Mitchell's Standard Superphosphate.

(Collected of J. & J. A. Rice, Worcester, Mass.)

Guaranteed composition: Ammonia, 2½ to 3½ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.); soluble phosphoric acid, 8 to 10 per cent.; potassium oxide, 3 to 4 per cent.

	Per cent.
Moisture at 100° C.,	11.18
Total phosphoric acid,	12.17
Soluble phosphoric acid,	3.71
Reverted phosphoric acid,	2.93

	Per cent.
Insoluble phosphoric acid,	5.53
Nitrogen,	2.11
Potassium oxide,	1.62
Insoluble matter,	8.68

Valuation per two thousand pounds: —

74.2 pounds of soluble phosphoric acid,	$7 42
58.6 pounds of reverted phosphoric acid,	5 27
110.6 pounds of insoluble phosphoric acid,	4 98
42 2 pounds of nitrogen,	8 44
32.4 pounds of potassium oxide,	1 38
	$27 49

Bradley's Complete Manure (Corn and Grain).

(Collected of Sheldon & Newcomb, Greenfield, Mass)

Guaranteed composition: nitrogen, 3.3 to 4 per cent. (equivalent to ammonia, 4 to 5 per cent.); available phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	9.05
Total phosphoric acid,	12.32
Soluble phosphoric acid,	7.37
Reverted phosphoric acid,	2.17
Insoluble phosphoric acid,	2.78
Nitrogen (in organic matter),	3.97
Nitrogen (in nitrates),	.16
Potassium oxide,	4.00
Insoluble matter,	4.93

Valuation per two thousand pounds: —

147.4 pounds of soluble phosphoric acid,	$14 74
43.4 pounds of reverted phosphoric acid,	3 91
55.6 pounds of insoluble phosphoric acid,	2 50
79.4 pounds of nitrogen (in organic matter),	15 88
3.2 pounds of nitrogen (in nitrates),	58
80. pounds of potassium oxide,	3 40
	$41 01

Complete Manure (Corn and Grain).

(Collected of H. L. Phelps, Northampton, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available), 5 to 6 per cent.; potassium oxide, 5 to 7 per cent.; nitrogen, soluble, in organic matter, in ammonia, 4 to 6 per cent.

	Per cent.
Moisture at 100° C.,	8.85
Total phosphoric acid,	7.09
Reverted phosphoric acid,	1.73
Soluble phosphoric acid,	3.26
Insoluble phosphoric acid,	2.10
Nitrogen (in organic matter),	2.05
Nitrogen (in nitrates),	.43
Nitrogen (in ammonia salts),	3 89
Potassium oxide,	8.36
Insoluble matter,	1.80

Valuation per two thousand pounds: —

34 6 pounds of reverted phosphoric acid,	$3 11
65.2 pounds of soluble phosphoric acid,	6 52
42. pounds of insoluble phosphoric acid,	1 89
167 2 pounds of potassium oxide,	7 11
41. pounds of nitrogen (in organic matter),	8 20
77 8 pounds of nitrogen (in ammonia salts),	17 12
8.6 pounds of nitrogen (in nitrates),	1 55
	$45 50

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of Sheldon & Newcomb, Greenfield, Mass.)

Guaranteed composition: Nitrogen 2½ to 3¼ per cent. (equivalent to ammonia, 3 to 4 per cent.); total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; available phosphoric acid, 9 to 11 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	14.75
Total phosphoric acid,	13.57
Soluble phosphoric acid,	8.44
Reverted phosphoric acid,	2.34
Insoluble phosphoric acid,	2.79
Potassium oxide,	1.59
Nitrogen (in organic matter),	2.97
Nitrogen (in nitrates),	.54
Insoluble matter,	5.25

Valuation per two thousand pounds: —

168.8 pounds of soluble phosphoric acid,	$16 88
46.8 pounds of reverted phosphoric acid,	4 21

55.8 pounds of insoluble phosphoric acid,	$2 51
31.8 pounds of potassium oxide,	1 35
59.4 pounds of nitrogen (in organic matter),	11 88
10.8 pounds of nitrogen, (in nitrates),	1 94
	$38 77

Chittenden's Bone.

(National Fertilizer Co, Bridgeport, Conn.; collected of Wilder & Puffer, Springfield, Mass.)

Guaranteed composition: Ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.65 to 2.47 per cent.); total phosphoric acid, 22 to 24 per cent.

	Per cent.
Moisture at 100° C.,	9.40
Total phosphoric acid,	25.37
Reverted phosphoric acid,	3.92
Insoluble phosphoric acid,	21.45
Nitrogen,	2.28
Insoluble matter,	1.65

Valuation per two thousand pounds: —

78.4 pounds of reverted phosphoric acid,	$7 06
429. pounds of insoluble phosphoric acid,	19 30
45.6 pounds of nitrogen,	8 20
	$34 56

Williams, Clark & Co.'s "Americus" Brand (Oats, Barley, Rye and Tobacco.)

(Collected of Bragg & Co., Springfield, Mass.)

Guaranteed composition: Available phosphoric acid, 6 to 8 per cent.; potassium oxide, 8 to 10 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.)

	Per cent.
Moisture at 100° C.,	13.91
Total phosphoric acid,	8.74
Soluble phosphoric acid,	4.93
Reverted phosphoric acid,	2.42
Insoluble phosphoric acid,	1.39
Nitrogen (in organic matter),	2.69
Nitrogen (in nitrates),	1.37
Potassium oxide,	7.83
Insoluble matter,	3.26

Valuation per two thousand pounds: —

98 6 pounds of soluble phosphoric acid,	$9 86
48.4 pounds of reverted phosphoric acid,	4 36
27.8 pounds of insoluble phosphoric acid,	1 25

53.8 pounds of nitrogen (in organic matter),	$10 76
27.4 pounds of nitrogen (in nitrates),	4 93
156.6 pounds of potassium oxide,	6 66
	$37 82

Bradley's XL Ammoniated Bone Superphosphate.

(Collected of R. T. Prentiss, Holyoke, Mass.)

Guaranteed composition: Soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; nitrogen, 2½ to 3¼ per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	16.65
Total phosphoric acid,	12.53
Soluble phosphoric acid,	8.44
Reverted phosphoric acid,	.98
Insoluble phosphoric acid,	3.11
Nitrogen (in organic matter),	2.93
Nitrogen (in nitrates),	.29
Potassium oxide,	1.60
Insoluble matter,	5.10

Valuation per two thousand pounds: —

168.8 pounds of soluble phosphoric acid,	$16 88
19.6 pounds of reverted phosphoric acid,	1 76
62.2 pounds of insoluble phosphoric acid,	2 80
58.6 pounds of nitrogen (in organic matter),	$11 72
5.8 pounds of nitrogen (in nitrates),	1 04
32. pounds of potassium oxide,	1 36
	$35 56

Stockbridge's Manures (Tobacco.)

(Collected of C. F. Brown, Northampton, Mass.)

Guaranteed composition: Nitrogen, 3.25 to 4.25 per cent. (ammonia, 4 to 5 per cent.); soluble and available phosphoric acid, 8 to 10 per cent.; calcium oxide, 8 to 10 per cent.; potassium oxide, 5 to 6 per cent.

	Per cent.
Moisture at 100° C,	14.98
Total phosphoric acid,	11.55
Soluble phosphoric acid,	6.17
Reverted phosphoric acid,	1.18
Insoluble phosphoric acid,	4.20
Nitrogen (in organic matter),	2.10
Nitrogen (in nitrates),	1.09
Potassium oxide,	5.09
Calcium oxide,	16.26
Insoluble matter,	6.39

Valuation per two thousand pounds: —

123.4 pounds of soluble phosphoric acid,	$12 34
23.6 pounds of reverted phosphoric acid,	2 12
84. pounds of insoluble phosphoric acid,	3 78
101.8 pounds of potassium oxide,	4 33
42. pounds of nitrogen (in organic matter),	8 40
21.8 pounds of nitrogen (in nitrates),	3 92
	$34 89

Williams, Clark & Co.'s "Americus" Ammoniated Bone Superphosphate.

(Collected of Slate & DeWolf, Greenfield, Mass.)

Guaranteed composition: Ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.6 to 2.5 per cent.); potassium oxide, 1 to 2 per cent.; soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.; insoluble phosphoric acid, 1 to 3 per cent.

	Per cent.
Moisture at 100° C.,	15 89
Total phosphoric acid,	9.28
Soluble phosphoric acid,	5.08
Reverted phosphoric acid,	3.02
Insoluble phosphoric acid,	1.18
Potassium oxide,	1.83
Nitrogen,	1.86
Insoluble matter,	6.28

Valuation per two thousand pounds: —

101.6 pounds of soluble phosphoric acid,	$10 16
60.4 pounds of reverted phosphoric acid,	5 44
23.6 pounds of insoluble phosphoric acid,	1 06
36.6 pounds of potassium oxide,	1 56
37.2 pounds of nitrogen,	7 44
	$25 66

Bay State Fertilizer.

(Clark's Cove Guano Co., New Bedford, Mass.; collected of E. S. Snow, Belchertown, Mass.)

Guaranteed composition: Moisture, 10 to 18 per cent.; nitrogen, 2.1 to 2.8 per cent.; (ammonia, 2.5 to 3.5 per cent.); total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 1 to 2 per cent.; insoluble phosphoric acid, 3 to 4 per cent.; potassium oxide, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	16.23
Total phosphoric acid,	12.86
Soluble phosphoric acid,	8.57
Reverted phosphoric acid,	1.12
Insoluble phosphoric acid,	3.17
Potassium oxide,	1.82
Nitrogen (in organic matter),	2.24
Nitrogen (in ammonia salts),	.56
Nitrogen (in nitrates),	.24
Insoluble matter,	5.25

Valuation per two thousand pounds: —

171.4 pounds of soluble phosphoric acid,	$17 14
22.4 pounds of reverted phosphoric acid	2 02
63.4 pounds of insoluble phosphoric acid,	2 85
36.4 pounds of potassium oxide,	1 55
44.8 pounds of nitrogen (in organic matter),	8 96
11.2 pounds of nitrogen (in ammonia salts),	2 46
4.8 pounds of nitrogen (in nitrates),	86
	$35 84

C. A. GOESSMANN,
State Inspector of Commercial Fertilizers.

APPENDIX.

COMPOSITION OF SOME COMPOUNDS IN FERTILIZERS.

One hundred parts of: —

Nitric acid contain 26 parts of nitrogen.

Ammonia contain 82.35 parts of nitrogen.

Pure nitrate of potassa (saltpetre) contain 53.4 parts of nitric acid and 46.6 parts of potassium oxide.

Pure nitrate of soda (Chili saltpetre) contain 63.25 parts of nitric acid.

Chloride of potassium contain 52.4 parts of potassium, 63.1 parts of potassium oxide and 47.6 parts of chlorine.

Pure sulphate of potassa contain 54.9 parts of potassium oxide and 46 parts of sulphuric acid.

Bone phosphate (tricalcic phosphate) contain 46 parts of phosphoric acid and 54 parts of calcium oxide (lime).

Calcined gypsum contain 41 parts of calcium oxide (lime) and 59 parts of sulphuric acid.

Uncalcined pure gypsum contain 32.5 parts of calcium oxide (lime), 46.5 parts of sulphuric acid and 21 parts of water.

Carbonate of lime contain 56 parts of calcium oxide (lime) and 44 parts of carbonic acid.

Sulphate of magnesia (free of water) contain 33.3 per cent. of magnesium oxide (magnesia) and 66.6 per cent. of sulphuric acid.

BOSTON, MASS., Jan. 31, 1885.

To the Massachusetts State Board of Agriculture.

GENTLEMEN: — I beg to enclose the annual reports of the Director and Treasurer of the experimental station at Amherst, for the year ending 1884.

Respectfully submitted.

O. B. HADWEN,
Secretary.

SECOND ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The work carried on at the experiment station during the past year, has been, as far as practicable, in conformity with the plans presented for your consideration at the first quarterly meeting of the Board.

The farm-house, originally designed for office and working rooms, has been changed into a dwelling-house for the farmer of the station, retaining one room for keeping the farm records. The grounds around the farm buildings have been rendered attractive by improvements in the roads and otherwise.

An experienced practical farmer, for several years previous tried in the service of the college, has been engaged since the first of April, 1884, to carry out, as directed, the practical work in the field and barn of the station.

Part of the stables for keeping animals for feeding experiments, have been fitted up, at an early date of the season, to meet the temporary requirements in that direction. Three feeding experiments — two with milch cows and one with pigs — are described within this report. Others are in progress, and will be reported, as soon as finished, in our periodical bulletins.

The work in the field has been in several directions, and to the full extent of the present resources. The underdrained plats described in the previous report, have been again planted with corn without manuring, to prepare them for special trials with various manurial substances, in connection with a careful examination of the drainage waters passing out.

Arrangements have been made to study the effect of commercial fertilizers, — compounded at the station, — on the quantity and the quality of the crops grown by their aid, as compared, in both directions, with the growth of the same plants upon unfertilized lands of a corresponding soil. Four standard grasses, two millets and one reputed variety of corn, are included in that trial. The mode of operation and the first year's results form part of the enclosed report.

Some field observations have been instituted to study the specific action of different forms of potassa — muriate and sulphate — on the character of the crops raised under their influence. Besides various kinds of small fruits, fruit trees, etc., a prominent crop, the potato, has been selected for that purpose.

Six reputed forage crops, vetch, serradilla, white lupine, horse bean, common lucerne, and sand lucerne, belonging to the valuable family of farm plants of which the clover is a conspicuous representative — *Leguminosæ* — have been planted with a view to study their adaptability to our climate, and eventually to increase our chances for raising a greater variety of nutritious fodder for farm live stock.

Many of these experiments will require years of close observation before reliable deductions can be safely drawn from the results obtained from them, — features more or less common to all field experiments, — a good argument in favor of an early beginning of the work.

The products of the garden and the orchard have received their share of attention. The work undertaken in these important branches of agricultural industry proposes to ascertain the quality, and the relative and absolute quantity, of mineral constituents of prominent fruits and garden crops. A more reliable information in that direction will secure for us a careful basis for special fertilization, and thereby a more rational mode of their cultivation. The results presented in this connection have been greatly increased by a series of valuable contributions of Prof. S. T. Maynard: observations in regard to insects injurious to the apple; notes upon insects injurious to farm and garden crops; on the causes of certain diseases of grasses; observations regarding the vitality of the seeds of various weeds; vitality of seeds as affected by age, and the destruction of peach buds by cold. His personal report forms the first chapter of this report.

The various crops raised in connection with the previously enumerated field experiments have, in most instances, been subjected to a chemical analysis, for the purpose of obtaining additional information for a judicious decision regarding their true character.

Experiments are under way with ensilaging fodder corn and pearl millet. A description of the results will be published as soon as the silo shall be opened for examination.

The work in the chemical labratory has been in various directions, and quite extensive, considering circumstances. Aside from the numerous analytical examinations in connection with the experiments in stock-feeding and in the field, a considerable number of fodder plants have been chemically tested for general information.

A large number of agricultural chemicals and other commercial manurial matter, not included in the control of the laws for the sale of licensed fertilizers, besides refuse material from various manufacturing industries throughout the State, have been analyzed at the request of farmer's clubs and farmers, in most instances at the special solicitation of the officers of the societies.

Many analyses of milk have been made, for the purpose of studying the influence of various kinds of feed on its quality.

Considerable attention has been given to the testing of drinking waters sent on from various localities in the State. The importance of attending more systematically, on farms, to the supply of a good water for drinking, has been discussed in a subsequent communication.

The calls upon the station for testing material of various descriptions, and interesting to farmers, have been quite frequently beyond its temporary resources, and had to be deferred at times, contrary to the best interest of the applicants.

Arrangements have been perfected of late to keep a complete weather record, and to assist the United States Signal

Service in the dissemination of useful knowledge. A set of ordinary meteorological instruments, uniform with those in use at Washington, have been placed in a suitably constructed and advantageously located little wooden structure, in the vicinity of the farm-house. As the record kept during past years upon the grounds has been incomplete, for want of suitable instruments, we have availed ourselves of the kindness of Miss S. C. Snell of Amherst, and insert a copy of her last year's weather record. In addition to this particular favor she has kindly consented to a copying of the entire elaborated weather record of her distinguished father, the late Prof. E. S. Snell of Amherst, Mass., which extended over nearly fifty years, and is one of the most valuable weather records within the United States. The copy of this record will be made with particular reference to the months of April and May and August and September, to meet the special interests of the farmers.

A consideration of the above enumeration of the work undertaken at the station during the past year, may show that it has been the aim to meet, as far as practicable, the purpose for which this institution has been established. The various directions in which experimental inquiries, thus far, have been inaugurated, it will be conceded, are of first importance, and open an extensive field for investigation. Some experiments promise valuable results at an early date, and others necessitate years of systematic observation; none of them can be neglected for any length of time without serious consquences to our farm industry. The work thus far outlined represents at best but a limited selection of subjects, regarding which better information is essential for a successful advancement of the best interest of our farmers.

To carry on any investigation in the field, the barn and the laboratory requires time, skill and pecuniary means. Experience teaches that first expenses for inaugurating a series of experiments are quite frequently comparatively small, and the necessity for skilful assistants less imperative, than when the work becomes more intricate in its advance, and calls for exceptional accommodations, more complicated and expensive apparatus, and a more liberal supply of skilled assistance.

The State experiment station furnishes no exception in this direction. For over two years the work has been carried on within the means furnished by the State, without incurring serious responsibility from a financial standpoint. The most rigid economy only has enabled the managers to meet, to some extent, the emergency of the case. This, even, has not been possible without serious detriment to the successful working of the station, and thus, ultimately, the best interests of the farming community. The requirements for carrying out the present system of management has of late reached a point where more means are indispensable in the interest of success. A short description of present conditions cannot fail to support my previous statement. The stalls for feeding are in some instances in an unfinished condition, and in the majority of cases only finished to serve temporary purposes. There are no means to secure animals most desirable for experiment, beyond a choice from the limited stock of the college.

The fields rented from the college are only properly treated as far as the experimental plats are concerned; the remaining larger portion of the area, consisting of exhausted grass land, had to be left in that undesirable condition, for want of means to render it more productive. Arrangements for producing steam, for carrying on experiments with the products of the dairy, and for keeping ice, are wanting. The same is the case with reference to suitable rooms for experiments to study the specific action of various forms of plant food under well defined conditions, for hot-beds and sheds. Many of the farm tools have still to be borrowed of the college, nor has the station thus far been able to compensate the college for the use of house, barn and fields.

The chemical work called for has long outgrown the resources of the present laboratory. Efficient chemical investigation needs better and more extensive rooms, and a larger and more selected supply of apparatus. Above all, more privacy is desirable for important chemical and other scientific work, than a part of a much frequented college building, constructed for a different purpose, can furnish. A new building, designed with a view to meet the present and still growing special wants of the station in the above-mentioned direction, will prove ultimately the best economy.

The scientific assistance has thus far been supplied, in a great measure, by recent graduates of the college, at rates insufficient to retain their services beyond a limited period of time; a circumstance detrimental to the successful accomplishment of scientific work of a more intricate character. To give a somewhat more reasonable compensation for their services would serve a twofold desirable purpose; *i. e.*, secure good work and prepare some graduates of our college for teachers in the higher branches of scientific and industrial education. It needs no additional arguments to show that the kind, the character and the extent of the services which this new institution shall render to the State, stand in a direct relation to the character and the special scientific skill of those charged with the work.

The best use which can be made of the results of a well-conducted experiment or analysis obtained in a public institution like the State Agricultural Experiment Station, consists in placing them at once in the hands of those interested in its work. To meet this end monthly bulletins, containing short statements of the work accomplished, have been sent out. The special calls for these publications increased rapidly from three hundred to two thousand. Want of means necessitated the discontinuance of these bulletins since November. There is at present no prospect of issuing new bulletins for several months hence, on account of the low state of finances. The work in barn and laboratories continues from day to day, and the results are allowed to accumulate without serving their principal purpose.

The activity of the station has not infrequently, for this reason, been exposed to an undeserved unfavorable criticism. More facts of a similar character might be presented, if needed, to justify the request to ask for better working rooms, better apparatus and a more liberal appropriation of money, to meet the united call of the working farmers of the State.

Other States, with less agricultural interests at stake, have appropriated of late more than twice the sum for their experiment stations than we receive at present, with a larger field of investigation assigned by our State laws.

In concluding my report, it gives me pleasure to express my sincere thanks for the kind consideration I have enjoyed from you during the past year, in the management of my charge.

I am, very respectfully,

C. A. GOESSMANN,
Director of the State Experiment Station

COMMUNICATION FROM PROF. S. T. MAYNARD.

1. OBSERVATIONS IN REGARD TO INSECTS INJURIOUS TO THE APPLE.

In the growth of all kinds of farm or garden crops, the farmer and gardener find themselves forced to wage constant warfare with insects or parasitic plant life. In this paper we give the results of a few observations in regard to the plum weevil or curculio (*Conotrachelus nenuphar*), as affecting the apple crop, compared also with the codling moth and the apple maggot.

It has often been noticed, early in the summer, that apples nearly all fall from the trees when quite small. This was especially the case during the past season, and a careful investigation was made to ascertain the cause. A tree of the variety known as the Westfield Seek-no-further, which blossomed very abundantly and set an unusually large crop of fruit, was selected. When from one-half to one inch in diameter, the fruit began to drop in large numbers, so that not enough was left on the tree for one-half a crop. A large quantity of these were collected and examined, and out of eight hundred it was found that all but three were punctured by the plum curculio, leaving its peculiar crescent-shaped mark, and in every puncture was found an egg or small larva. The worms commonly found in the apple at this time have generally been supposed to be the larvæ of the codling moth (*Carpocapsa pomonella*), yet in the number examined only four or five of the larvæ of the latter were found.

The remedies which have been successfully employed to prevent the injury of the plum crop by these larvæ are two; *i. e.*, (1) that of jarring the trees and catching the insects and affected fruit in a sheet stretched on a frame or spread on the ground, and destroying them; and (2) that of planting the trees in limits of poultry yards. The first remedy cannot be applied to the apple tree on account of its size. The second has proved successful in saving the plum crop, and would undoubtedly be as successful with the apple; but the fowls should be numerous enough to not only catch the insects when they come from the ground, but also to let none of the larvæ escape when they come from the fallen fruit to go into the ground. Perhaps a more sure preventive would be, in addition to the above, to have the fruit destroyed by pasturing swine in the orchard in sufficient numbers to eat all of the fruit as soon as it drops.

The apple crop is also very much injured by the larvæ of the codling moth, mentioned above, which has been common for a long time, and the apple maggot (*Tripeta pomonella*), which has only done serious damage within the past five years. The latter injures the fruit by making burrows in the flesh, many larvæ or maggots often working in the same apple. The eggs are laid by a small fly, — somewhat resembling the common house-fly, but not more than one-half its size, — through a small opening in the skin of the apple made with its ovipositor. It shows especial liking for the thin-skinned, mild, sub-acid or sweet summer or autumn varieties, but also attacks some winter varieties. Its ravages have become so extensive in some localities that prompt measures must be taken for its extermination, or it may work the total destruction of the apple crop.

The practice of pasturing swine in the summer is being recommended and practised by many of our leading farmers and stock-breeders, and the orchardist must combine to a certain extent this branch of business with his own if he would be successful, for the destruction of the fruit as it falls from the tree is the only *safe* and *sure* remedy now known to prevent injury by these three insects.

2. NOTES UPON INSECTS INJURIOUS TO FARM AND GARDEN CROPS.

In the First Annual Report of the station is to be found a statement of experiments made to ascertain the best means of destroying the many insects that make havoc among the crops of the farm and garden. Some of the experiments gave satisfactory results, and extended preparations are being made to learn more of the *more harmless materials* that may be used as insecticides. As the results cannot be presented to the public in time to be of use the early part of this season, we give a brief statement of the remedies thus far found to be the most successful.

Cabbage Flea. — The first insect of importance that appears is the small black flea or jumping beetle that attacks the cabbage, radish, turnip, etc. Dusting with paris green mixed with one hundred times its weight of plaster has proved an effectual remedy. This must be done when the plants are wet, and after every rain.

Cut-worm. — The cut-worm, of which there are several species, including the army worm, works only during the night, and may be destroyed by the same remedy as the above. We would advise a trial of pyrethrum powder mixed with five times its bulk of plaster as being more safe, although we have no positive proof that it will be effectual.

Striped Squash-Bug. — The striped squash-bug, which has been so abundant for the past two seasons, is best kept in check by the use of plaster and paris green. For the family garden the safest and most satisfactory way to overcome them is to make a bottomless box twelve inches square and six or eight inches deep, and cover it with mosquito netting. One of these boxes placed over each hill until the plants have become tough and hard, is a sure protection.

The Potato Beetle. — The potato beetle has evidently become a permanent resident among us. Paris green extended with plaster, flour or water, is the only cheap and easily applied remedy known at present; but great care must be exercised in its use, and especially in the place where the package is kept, that it may not get upon the food of animals.

Cabbage Worm. — The cabbage worm, the larva of the common white butterfly, may be easily destroyed in several ways. That of hand-picking, if begun before the first brood has passed into its perfect state, is effectual. We have also found that pyrethrum powder mixed with five times its bulk of plaster, and dusted into the centre of the leaves with sulphur bellows, is certain destruction to every one of them. The application of insecticides in liquids to the cabbage has not been satisfactory, on account of the peculiar structure of the leaf surface, which allows the water to roll off in drops, and not adhere to any part of it. Paris green is unsafe to use after the leaves have become over four inches in diameter.

Currant Worm — The currant worm should be destroyed while small, with the dust of hellebore or pyrethrum. The latter being perfectly harmless is to be more highly recommended.

Plum Weevil. — There are two certain methods of capturing the plum weevil; the first by jarring the tree early in the morning and catching them upon sheets stretched below upon a frame or upon the ground, and the second by placing chicken coops under the trees. The former method must be attended to regularly every morning for three weeks after the plums have set; and in the latter case, if the number of trees is large, a large flock of chickens will be required to make that remedy effectual.

Codling Moth. — No positive remedy against the ravages of this insect has as yet been found. It is claimed that paris green sprayed over the tree in water is effectual; but should it prove so, it is far too dangerous a remedy to apply where grass or other crops are growing under them.

Apple and Peach Borer. — For the destruction of these two insects no sure remedy has been found, except the knife. It is probable that covering the trunk of the tree near the ground with the ink or tar used to catch the moths of the canker worm, or wrapping around the trunk bands of tarred paper, would assist in keeping them away.

The Rose Bug. — The rose bug has thus far been the most difficult to overcome of the whole tribe of injurious insects, and we can recommend no remedy with a great degree of confidence, but would advise the trial of the fumes of gas tar held under the vines a short time every evening while the grapes are forming. It is certainly offensive to them, and if used carefully need not injure the plant.

Rose Slugs. — This insect is easily destroyed by spraying with water and pyrethrum, at a rate of one tablespoonful of the latter to a pailful of the former.

Letters. — Several letters have been received asking for information in regard to insects and fungus injurious to plants, which have been answered by letter, and for general information we insert the answers of a few of them.

Letter No. 1, containing shoots of the apple tree covered with a coating of black masses containing some fungus growth. These black masses are the result of dust adhering to the shoots made sticky by the exudations of the common apple aphis or plant louse, which were unusually abundant the past two seasons and caused great injury to young trees. The remedy is to syringe with strong soapsuds, or with a tablespoonful of pyrethrum in a pail of water.

Letter No. 2, containing twigs of the peach tree in which were found a double row of the eggs of the tree cricket (*Oecanthus niveus*). This insect lays its eggs more commonly in the branches of the raspberry and blackberry, but in some cases in those of the peach and plum. The larvæ, after hatching, leave the twigs and for a time feed upon plant lice, and later in the season upon succulent ripe fruits. The tree cricket is light green in color, and when full grown is about three-fourths of an inch long, and lays its eggs in autumn in the centre of the shoots in long lines, as mentioned above.

3. ON THE CAUSES OF CERTAIN DISEASES OF GRASSES.

June Grass and White Top. — To this grass, on account of the many inflorescences that fail to mature and turn white, is often given the name of *white top*, and the question is often asked, "What is the cause of this condition?" Upon careful investigation it has been found that this condition is most prevalent upon land exhausted by long cropping, or where the roots have been much injured by the larvæ of the June bug or May beetle. The turning of the top to a white color is due to the destruction of the culm or stalk, just above the last leaf, by a fungus growth. Upon rich land, and where there are few insect larvæ working at the roots, there is little or none of this white top, and we are led to reason that the fungus does not attack the stem of the grass until the cells have become weakened in some way.

4. Observations Regarding the Vitality of the Seed of Various Weeds.

The several subjects submitted to me for answers by the Board of Control have been carefully investigated, and I am able to make the following report: —

1. How is the vitality of the seeds of our most common weeds, such as dock, sorrel, chickweed, shepherd's purse, white daisy, etc., affected by the action of the digestive organs of animals?

Answer. Seeds of the dock, sorrel, daisy and shepherd's purse were fed to a horse and the refuse collected. Upon careful examination it was found that the seeds, unless crushed, were uninjured, and germinated readily when placed in soil, under proper conditions of heat and moisture. The experiment was repeated several times with the same result.

2. How is the vitality of the common weed seeds, like the above, affected by the action of the compost heap?

Answer. Having settled the point that weed seeds are not destroyed by the action of the digestive organs of animals, it becomes important to know how their vitality may be destroyed; for while the thorough farmer should never allow weeds to mature their seeds on his farm, there are many instances where it becomes necessary to provide some means by which chance seeds may be destroyed. A series of experiments were carried out, the result of which is, that seeds are destroyed if exposed to a temperature of from 90° to 110° F. for from five to seven days in a moist compost heap. In a dry compost heap, where the temperature runs as high as the above, the seeds were found but little injured. The tests were applied only to the above-named seeds; but it is probable that the results would be the same upon others, as these are among the seeds of the greatest vitality. The efficiency of this mode of destruction depends upon the maintenance of a continued high temperature and moisture, which will cause the seeds to either germinate and then decay, or to decay before germinating. The amount of moisture can be easily regulated, and by properly working over any pile of compost containing a large amount of organic matter, the required amount of heat may be obtained. From the above experiments it would seem doubtful if the practice of keeping swine upon manure piles, to cause slow decomposition, is the best for manure containing weed seeds. It is also doubtful if the seeds of weeds, often put into the pens where pigs are kept, will be destroyed by the action of the little heat there generated. It would probably be safer, in both of the above cases, to compost the manure in large piles before using it upon the land.

3. At what stage of blooming are the seeds of the white daisy (*Leucanthemum vulgare*) matured enough to germinate?

Answer. This weed has become so abundant in the grass land of some sections of the State that it must be cut with the grass, and it becomes important to know if it can be cut with the grass before the seeds mature. After a series of careful examinations it has been decided that when the flower first reaches its full expansion few or no seeds are mature enough to germinate, but that it requires only a few days for these seeds to mature to full ripeness.

In view of these facts it would not seem safe for the farmer to depend wholly upon the early stage of cutting, but to afterwards compost all manures made from fodder containing weed seeds of any kind.

5. VITALITY OF SEEDS AS AFFECTED BY AGE.

The question of the vitality of seeds as affected by age, is one of great importance to every cultivator of the soil, and while our experiments are far from being complete, as far as the number of varieties are concerned, yet we give the results, hoping at some future time to extend the tests to other varieties of seeds and perhaps to those of greater age.

The temperature, moisture and other conditions, during these tests, were made very nearly that required for the best growth of each kind, and *duplicate* tests were made, in all cases, to insure accuracy.

For each test ten seeds were taken, and the results are given below: —

COLLECTION NO. 1.

(Put up by Wm. Lyman, Leverett, Mass., in 1868.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	Pop-corn,	–	20
2	Yellow Field Pumpkin,	–	20
3	Tomato,	–	20
4	White Spine Cucumber,	–	20
5	Boston Marrow Squash,	–	20
6	Stowell's Evergreen Corn,	–	20
7	Pepper,	1	2
8	Mountain-Sweet Watermelon,	–	20
9	Ox-heart Cabbage,	–	20
10	Giant White Celery,	–	20
11	Large Red Wethersfield Onion,	–	20
12	Sage,	–	20
13	Early Horn Carrot,	–	20
14	White Flat Turnip,	1	14
15	Drumhead Lettuce,	–	20
16	Early Scarlet Radish,	–	20
17	Early Turnip Beet,	5	16
18	Large Dutch Parsnip,	–	20
19	Dan O'Rouke Pea,	–	20

COLLECTION NO. 2.

(Collected by Student, from 1868 to 1872.)

1	Com'n Golden Rod (Solidago Nemoralis),	–	20
2	Com'n Golden Rod (Solidago Lanceolata),	–	20
3	Com'n Golden Rod (Solidago Canadense),	–	20
4	Com'n Plantain (Plantago Major),	–	20
5	Apple,	–	20
6	Quince,	–	20
7	White Birch,	–	20
8	Citron Melon,	–	20
9	Musk Melon,	3	12
10	Cucumber,	–	20
11	Hubbard Squash,	6	10
12	Broom Corn,	–	20
13	Thoroughwort,	–	20
14	Common Milkweed,	–	20
15	Fire-weed,	–	20
16	Beggar's Tick,	–	20
17	Butter-weed,	–	20
18	Stag-horn Sumac,	–	20
19	Evening Primrose,	–	20
20	Cone Flower,	–	20
21	Tobacco, Connecticut Seed-leaf,	–	20
22	Sweet Brier,	–	20
23	Pigweed,	–	20
24	Curled Dock,	–	20
25	Smartweed,	–	20
26	Sunflower,	–	20
27	Rhubarb,	–	20

COLLECTION NO. 3.

(Collected by Students in 1878.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	White Tazelbe Wheat, ...	–	20
2	Arnouth Spring Wheat, ...	–	20
3	Black Swedish Oat, ...	–	20
4	Somerset Oat, ...	–	20
5	Schonen White Oat, ...	–	20
6	Excelsior Oat, ...	–	20
7	Probstier Barley, ...	–	20
8	Saxonian Barley, ...	–	20
9	Red Clover, ...	10	4
10	Yellow Clover, ...	10	4
11	Alfalfa Clover, ...	10	4
12	Alsike Clover, ...	2	6
13	Bokhara Clover, ...	5	4
14	White Clover, ...	6	4
15	Lucerne, ...	10	4
16	Winter Rape, ...	10	3
17	Summer Rape, ...	10	3
18	Desmodium, ...	–	20
19	Teasels, ...	–	20
20	Fengreek, ...	10	3
21	Vetch, ...	5	10
22	Lentile, ...	–	20
23	Blue Lupine, ...	3	6
24	White Lupine, ...	10	6
25	Carter's Imperial Pea, ...	–	20
26	Nohoot Pea, ...	–	20

COLLECTION NO. 4.

(Seed taken from a German Collection made in 1878.)

1	Trifolium Pratense, ...	5	7
2	Trifolium Hybridum, ...	4	7
3	Festuca Ovina (Sheep Fescue), . . .	2	12
4	Festuca Pratensis (Meadow Fescue), .	9	12
5	Festuca Duriuscula (Hard Fescue), . .	–	–
6	Lolium Perenne (Perennial Rye-grass), .	3	12
7	Lolium Italicum (Annual Rye-grass), .	8	12
8	Poa Pratensis (June-grass), ...	–	20
9	Poa Nemoralis (Wood Meadow-grass), .	–	20
10	Dactylis Glomerata (Orchard-grass), .	–	20
11	Agrostis Vulgaris (Red Top), ...	–	20
12	Agrostis Stotonifera (Creeping Bent-grass),	10	16
13	Anthoxanthum Oderatum, ...	5	14
14	Alopecurus Pratensis (Meadow Foxtail), .	–	20
15	Phleum Pratense (Timothy Hay), . . .	8	12
16	Aira Flexuosa (Hair-grass), ...	–	20
17	Medicago Sativa (Lucerne), ...	10	5

Collection No. 5.

(Seeds put up by J. M. Thorburn & Co., 1883.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	Festuca Ovina (Sheep's Fescue), . .	–	20
2	Festuca Elatior (Meadow Fescue), . .	5	9
3	Festuca Rubra (Red Fescue), . . .	10	9
4	Festuca Duriuscula (Hard Fescue-grass),.	2	9
5	Poa Pratensis (June-grass), . . .	4	10
6	Agrostis Vulgaris (Red-Top grass), . .	–	–
7	Agrostis Stotonifera (Creeping Bent-grass),	–	–
8	Bromus Mollis (Soft Chess-grass), . .	4	9
9	Lolium Perenne (Perennial Rye-grass), .	10	9
10	Lolium Italicum (Annual Rye-grass), .	6	9
11	Alopecurus Pratensis (Meadow Foxtail), .	–	–
12	Aira Flexuosa (Hair-grass), . . .	–	
13	Avena Elatior (Oat-grass), . . .	4	9
14	Avena Flavescens (Yellow Oat-grass), .	5	10
15	Dactylis Glomerata (Orchard-grass), .	7	9
16	Authoxanthum Oderatum (Sweet Vernal-grass, ...	8	10
17	Phleum Pratense (Timothy-grass), . .	9	9
18	Panicum Germanicum (Hungarian Millet),	8	9
19	Phalaris Arundinancea (Blue Joint-grass),	6	9
20	Holcus Lanatus (Soft Grass), . . .	6	9
21	Cynosurus Cristatus (Crested Dogtail), .	10	10
22	Reana Luxuriens, ...	–	–
23	Bermuda Grass, ...	–	–
24	White Clover, ...	10	2
25	Red Clover,.	10	2
26	Crimson Clover, ...	10	2
27	Alsike Clover, ...	10	2
28	Alfalfa Clover, ...	10	2
29	Yellow Clover, ...	10	2
30	Bokhara Clover, ...	10	2
31	White Lupine, ...	10	7
32	Blue Lupine, ...	5	6
33	Yellow Lupine, ...	6	6
34	Vetch, ...	10	6
35	Horse Bean, ...	10	7
36	Spurry, ...	4	6

It will be seen that those varieties which, as a rule, are most hardy and productive, and consequently most generally planted, have generally retained their vitality the longest.

6. The Destruction of Peach Buds by Cold.

In New England one of the greatest obstacles met with in the cultivation of the peach is the destruction of the fruit buds by cold.

Many theories have been advanced to account for this injury, and in order to obtain definite knowledge of the condition of the buds during the season when the injury takes place, examinations were made at intervals of from three to five days from November 15th to the time of their destruction. At the beginning of the examinations, the buds were all found to be in a fully matured condition and the bud scales very closely united, making the bud firm and compact. This condition continued until after the warm days of the last of November.

December 6th the buds scales were found to have loosened and the stamens and pistils to have increased very much in size. December 16th some buds were found to have been destroyed altogether. The temperature at this time had only reached 18° above zero. Most of the buds, however, only indicated an advanced stage of growth; in a few instances, the rudimental petals began to take on some color.

Upon examination after the severe cold of December 19th and 20th, every bud examined, whether growing upon high or low land, or with a northern or southern exposure, was found to be destroyed.

The facts brought out by the above examination, were as follows: that the buds were started into growth by the warm days of the last of November and the first of December; that in this condition some of them were destroyed at a temperature of 18° above zero; and that all were destroyed when the temperature reached 10° below zero.

What would have been the effect of this amount of cold upon buds in a less advanced state of growth, cannot be determined until we have a season less favorable for their development.

ON FEEDING EXPERIMENTS.

C. A. GOESSMANN.

Careful investigations in stock-feeding have taught us lessons similar to those we have learned to appreciate in feeding plants, or in the cultivation and the production of farm crops. All our farm plants need nitrogen, phosphoric and sulphuric acids, potassa, soda, lime, magnesia and iron; yet not two species of plants have been found, which need the same quantity of these substances, during their entire period of life, nor at any stage of their growth. No one of the above-stated essential mineral constituents of plants can replace another one to any extent without altering the character of the plant, or even endangering its life. Potassa cannot take the place of lime, nor phosphoric acid that of sulphuric acid. When lime is needed, a shovelful of that substance is worth more than any quantity of the many times more expensive potassa. That particular mineral element which supplies an actual want of the soil is, for this reason, from a physiological standpoint, considered the most important one for the production of the plant; for without it the remaining essential mineral constituents of plants, whatever their quantity may be, cannot make them grow.

In regard to the growth and the support of our farm live stock, similar relations have been noticed. Actual feeding experiments have shown that three groups of plant constituents (nitrogenous, non-nitrogenous, and mineral constituents) are required to sustain successfully animal life. No one or two of them, alone, can support it for any length of time. In case the food does not contain digestible non-nitrogenous substances, the fat and a part of the muscles of the animal on trial will be consumed in the support of respiration before its life terminates. In case nitrogenous constituents are excluded, the formation of new blood and flesh from the food consumed ceases, for the animal system is not capable of producing their principal constituents from anything else than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances directly from the plants; carnivorous animals indirectly, by feeding on herbivorous animals. We feed, at present, our farm stock too frequently without a due consideration of the general natural law of nutrition; to deal out our fodder crops only with mere reference to name, instead of making ourselves more familiar with their composition and their particular quality, deprives us even of the chance of drawing an intelligent conclusion from our present system of feeding.

To compound the animal diet with reference to the *particular organization* of the *animal*, its *age* and its *functions*, is of no more importance than to select the fodder substances with reference to *its special wants*, as far as the *absolute* and *relative quantity* of the *three essential groups* of food constituents are concerned.

The peculiar character of our home-raised fodder articles is apt to conceal their special deficiency for the various purposes they are used for in a general farm management. They all contain the three essential food constituents, yet in widely varying proportions, and they ought, therefore, to be supplemented in different directions, to secure their full economical value. To resort to more or less of the same fodder article to meet the special wants, may meet the case as far as an *efficient* support of the animal is concerned, yet it can only in exceptional cases be considered good economy.

To satisfy the craving of the stomach and to feed a nutritious food are both requirements of a healthy animal diet, which, each in their own way, may be complied with. The commercial fodder substances, as oil-cakes, meal refuse, brans and our steadily increasing supply of refuse material from breweries, starch works, glucose factories, etc., are admirably fitted to supplement our farm resources for stock-feeding; they can serve in regard to animal growth, and support, in a similar way as the commercial fertilizer in the growth of farm crops, by supplementing our home resources.

To feed an excess of fodder materials, as roots and potatoes, which contain a large proportion of non-nitrogenous substances, as starch, sugar, digestible cellular substance, etc., means direct waste; for they are ejected by the animal, and do not materially benefit the manure heap. In case of an excessive consumption of nitrogenous constituents, a part of the expense is saved in an increased value of the manure, yet scarcely enough to recommend that practice beyond mere exceptional cases. The aim, therefore, of an economical stock-feeding must be to compound our various fodder materials in such a manner that the largest quantity of each of the three groups of fodder substances which the animal is capable to assimilate, should be contained in its daily diet to meet the purpose for which it is kept.

To compound the fodder rations of our farm stock with reference to the special wants of each class of them, is an essential requirement for a satisfactory performance of their functions; to supply these wants in an economical way controls the financial success of the industry.

The problem is an intricate one; years of careful experimenting were required to accumulate observations sufficient in number and in quality, to impart to the conclusion arrived at the claim of being worthy of a serious consideration. The first attempt to lay down rules for compounding the fodder rations of all kinds of farm stock on rational scientific principles, was made by Dr. Grouven, director of the Agricultural Experiment Station at Salzmünden, Germany, 1858–1864. He began his work with a critical compilation of feeding experiments made by competent parties, some ninety in number, his own extensive experiments included. He ascertained in each case the amount of each fodder substance consumed per day during each experiment; and calculated subsequently, from their analyses, the character and the amount of the daily fodder rations.

By this operation he learned the exact amount of nitrogenous, non-nitrogenous and mineral substances digested per day, under definite circumstances, by each class of farm animals. The amount of fat which had been fed in the fodder substances was separately recorded, on account of its exceptionally high feeding value, as a heat-producing material.

The results of his calculations were repeatedly tried by actual feeding experiments, to test the correctness of his conclusions. The main object of Grouven's work consisted in bringing the results of more than twenty years' careful investigations within the reach of the practical farmer. In presenting his fodder standards to them, he recognized the natural imperfections of a first effort, More than twenty years additional experience in leading European agricultural experiment stations has modified some details in Grouven's statement; yet the great value of his method to compound rational, and thus more economical fodder rations for farm animals, has received an unqualified endorsement.

For more details regarding the subject here under discussion I refer to some previous publications contained in the reports of the Secretary of the Massachusetts State Board of Agriculture; see 1879–80, pages 221 to 237; 1882–83, pages 89 to 127.

The station proposes to benefit by the lessons of the past as far as the application of the method of compounding fodder rations for various kinds of live stock is concerned; yet leaves the working out of a rational and economical diet to the teachings derived from home experiments. The results of a few feeding experiments carried on at the station are reported with such details as will enable the student of a rational system of stock-feeding, as well as the farmer, to obtain the desired information. Whenever our results have accumulated in sufficient degree to entitle to a generalization, a more detailed discourse will follow.

I. — NOTES ON FEEDING EXPERIMENTS WITH CORN ENSILAGE.

The experiments were chiefly carried on for the purpose of testing the feeding value of corn ensilage, as compared with that of hay. A description of the general character of the ensilage, as well as of the hay and corn meal used in this connection, will be found upon a few subsequent pages within this report.

Three cows — crosses between native stock and Ayrshires — of a corresponding milking period — were selected from the herd of the Massachusetts Agricultural College, to serve for the trial. The previous mode of feeding, the amount of each article of fodder actually consumed per day, and the daily yield of milk, were carefully noted during the week preceding the removal of the animals to the stalls of the station (April 7–14). Each cow had received for some time previous to that date, four quarts of clear corn meal per day, together with all the hay they could consume.

This mode of feeding was continued at the station, from April 14 to 29, by careful application of the scale in all measurements to secure reliable values for comparison.

History of Cows.

I. Name, FAIRY; age, 5 years; weight, 862 pounds; number of calves, 2; last calf, Feb. 20, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 17 pounds of hay per day. Average yield of milk per day, 18½ pounds (April 14 to 30).

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C., ...	87.46	87.67	87.54
Total solids, ...	12.54	12.33	12 46
Fat (in solids), ...	3.33	3.20	3.34

Mean of Three Analyses.

Water, ...	87.56
Total solids, ...	12.44
Fat (in solids), ...	3.29

II. Name, NELLIE MAY; age, 4 years; weight, 860 pounds; number of calves, 2; last calf, Feb. 15, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 16½ pounds of hay per day. Average yield of milk per day, 14½ pounds.

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C., ...	87.57	87.18	87.09
Total solids, ...	12.43	12.82	12.91
Fat (in solids), ...	3.71	3.82	3.87

Mean of Three Analyses.

Water, ...	87.28
Total solids	12.72
Fat (in solids), ...	3.80

III. Name, CLARA; age, 5 years; weight, 895 pounds; number of calves, 3; last calf, Feb. 25, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 15½ pounds of hay per day. Average yield of milk per day (April 14 to 30) 15½ pounds.

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C.,	88.04	87.32	87 39
Total solids,	11.96	12.68	12.61
Fat (in solids),	3.27	3.48	3.56

Mean of Three Analyses.

Water,	87.58
Total solids,	12.42
Fat (in solids),	3.44

Statement of Dry Vegetable Matter Consumed in form of Hay and Corn Meal by each Cow before Ensilage was introduced.

I.—FAIRY.

		Dry Matter.	Cost.
Hay consumed per day,	17.00 lbs.	15.30 lbs	12.75 cts.
Meal consumed per day,	6.50 lbs.	5.60 lbs.	9.10 cts.
	23.50 lbs	20.90 lbs.	21.85 cts.

Daily produce of milk,	9¼ quarts.
Cost of fodder per day,	21.85 cents.
Cost of milk per quart,	2.36 cents.

II.—NELLIE MAY.

		Dry Matter.	Cost.
Hay consumed per day,	16.33 lbs.	14.70 lbs.	12.25 cts.
Meal consumed per day,	6.50 lbs.	5.60 lbs.	9.10 cts.
	22.88 lbs.	20.30 lbs.	21.35 cts.

Daily produce of milk,	7¼ quarts.
Cost of fodder per day,	21.35 cents.
Cost of milk per quart,	2.93 cents.

III. — CLARA.

		Dry Matter.	Cost.
Hay consumed per day, . . .	15.46 lbs.	13.90 lbs.	11.60 cts.
Meal consumed per day, . . .	6.50 lbs.	5.60 lbs	9.10 cts.
	21.96 lbs.	19.50 lbs.	20 70 cts.

Daily produce of milk, ...	7.6 quarts.
Cost of fodder per day, ...	20.7 cents.
Cost of milk per quart, ...	2.7 cents.

After the previously stated mode of feeding, and the quantity and quality of the milk obtained thereby, had been carefully tested during two weeks' observation under the management of the station,

Corn Ensilage

was introduced as an additional article of the daily diet, in the following way: The amount of corn meal, four quarts (6½ pounds) per day, remained the same during the entire trial. The ensilage was gradually substituted for the hay in the daily fodder, as the animal felt disposed to consume it. During the first twelve days of the experiment, each was offered forty pounds of ensilage per day, and subsequently sixty pounds, besides all the hay they would consume. They varied widely in their preference, as subsequent detailed statements show. The manner of feeding was as follows: At 5.30 A. M. the meal and shorts were fed to the animals during milking, and at 6 o'clock the ensilage; at 12 o'clock, M., from four to five pounds of hay were offered, and at 5 P. M. the remainder of the meal was given, and the rest of the ensilage soon after. At 8 o'clock, P. M. from four to five pounds of hay were again offered. .Any material remaining after each feeding was removed and weighed. As a rule, they consumed first the leaves of the corn, and left, if any, more or less of the harder stem parts behind. They received twice per day all the water they would drink.

I. — Name, FAIRY.

[A.] *Record of Month of May.*

1884. FEEDING PERIOD.	Food Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1–6,	6½	8	40	10	9	18.
6–12,	6½	8	40	10⅓	9	18.
12–18,	6½	7⅓	59	10	9	19.9
18–31,	6½	7⅓	54½	10	9	19.4

Analyses of Milk.

Water,	87.16	86.99	86.84	87.33	87.55	87.57
Solids,	12 84	13.01	13.16	12.67	12.45	12.43
Fat (in solids),	4.08	3.88	3.93	3.60	3.29	3.37

Mean of Three Last Stated Analyses of Milk.

Water,	87.41
Solids,	12.59
Fat (in solids),	3.43

The cows, with the exception of No. III., retained their original weight well.

[B.] *Record of Month of June.*

	Food Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	6½	–	8	55	9½	8	17½	20.0	–
2, . .	"	–	8	60	9½	8	17½	20.6	–
3, . .	"	–	8	60	10	9	19	20.6	885
4, . .	"	–	8	60	10	9½	19½	20.6	–
5, . .	"	–	7	60	10	9½	19½	19.7	–
6, . .	"	–	8	60	10½	9½	20	20.6	–
7, . .	"	–	8	60	10	9½	19½	20.6	–
8, . .	"	–	7	58	11½	9	20½	19.5	–
9, . .	"	6½	7	60	11	9½	18½	25.4	–
10, . .	"	"	7	60	11	9	20	25.4	–
11, . .	"	"	7	60	11	9	20	25.4	–
12, . .	"	"	6	60	11	10	21	24.5	–
13, . .	"	"	6	60	11	10	21	24.5	–
14, . .	"	"	7	55	11	10	21	24.8	–
15, . .	"	"	8	60	11	10	21	26.3	–
16, . .	"	"	8	57	11	10	21	25.9	–
17, . .	"	"	16	Discontinued; stock of ensilage exhausted.	11	10	21	25.7	910
18, . .	"	"	15		10½	10	20½	24.8	–
19, . .	"	"	15		11	10	21	24.8	–
20, . .	"	"	14		10½	10	20½	23.9	–
21, . .	"	"	14		10	10	20	23.9	–
22, . .	"	"	14		10½	10	20½	23.9	–
23, . .	"	"	15		10	9½	19½	24.8	–
24, . .	"	Discontinued.	*16		10½	9	19½	20.0	885
25, . .	"		*20		10½	10	20½	23.6	–
26, . .	"		*20		10½	9½	20	23.6	–
27, . .	"		*20		10	9½	19½	23.6	–
28, . .	"		*20		10	10	20	23.6	–
29, . .	"		*20		10	10	20	23.6	–
30, . .	"		*20		10	10	20	23.6	–

* New hay.

Analyses of Milk.

	June 10.	June 16.	June 30.
Water, ...	87.10	86.60	87.36
Solids, ...	12.90	13.40	12.64
Fat (in solids), ...	3.61	3 83	3.53

II. — NAME, NELLIE MAY.

[A.] *Record of Month of May.*

1884. FEEDING PERIOD.	FOOD CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
PERIODS.						
May 1–6, ...	6½	7½	40	8½	7½	17.6
6–12, ...	6½	7⅓	40	8⅓	7	17.4
12–18, ...	6½	6	54	8	7⅓	18.1
18–31, ...	6½	5⅔	45½	8	7⅓	16.7

Analyses of Milk.

	May 3.	May 7.	May 12.	May 20.	May 23.	May 26.
Water, ...	87.00	87.09	87.43	87.39	87.19	87.37
Solids, ...	13.00	12.91	12.57	12.61	12.81	12 63
Fat (in solids), . . .	3.81	3.91	3.86	3.80	3.68	3.68

Mean of three last stated Analyses of Milk.

Water, ...	87.32
Solids, ...	12.68
Fat (in solids), ...	3.72

[B.] *Record of Month of June.*

	Food Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	6½	–	7	37	8	7	15	16 7	–
2, . .	"	–	8	28	8	7	15	16.4	–
3, . .	"	–	7	35	8½	7	15½	16.7	852½
4, . .	"	–	6	40	8½	8	16½	16.2	–
5, . .	"	–	5	40	8	8	16	15.3	–
6, . .	"	–	7	40	9	8	17	17.1	–
7, . .	"	–	7	40	9	8½	17½	17.1	–
8, . .	"	–	5	40	10½	8	18½	15.3	–
9, . .	"	6½	5	40	10	9	19	21.0	–
10, . .	"	"	7	40	10	8½	18½	22.8	–
11, . .	"	"	7	40	10	9	19	22 8	–
12, . .	"	"	7	40	9½	9	18½	22.8	–
13, . .	"	"	6	40	10	9	19	21.9	–
14, . .	"	"	6	40	10	9	19	21.9	–
15, . .	"	"	7	40	10	9	19	22.8	–
16, . .	"	"	7	40	10	10	20	22.8	–
17, . .	"	"	16	40	10	10	20	25.7	895
18, . .	"	"	14	Discontinued; ensilage exhausted.	9½	9	18½	23.9	–
19, . .	"	"	13		9½	9	18½	23.0	–
20, . .	"	"	13		9½	9	18½	23.0	–
21, . .	"	"	14		9½	9	18½	23.9	–
22, . .	"	"	14		9½	9	18½	23.9	–
23, . .	"	"	15		9	9	18	24.8	–
24, . .	"	Discontinued.	*16		10	9	19	20.0	902
25, . .	"		*20		9½	9	18½	23.6	–
26, . .	"		*16		9½	9	18½	20.0	–
27, . .	"		*20		9	9	18	23.6	–
28, . .	"		*20		9½	9	18½	23.6	–
29, . .	"		*20		9½	9	18½	23.6	–
30, . .	"		*20		9	9	18	23.6	–

*New hay.

Analyses of Milk.

	June 16.	June 20.
Water, ...	86.89	87.20
Solids, ...	13.11	12.80
Fat (in solids), ...	3.81	3.83

III. — Name, CLARA.

Record of Month of May.

1884. FEEDING PERIOD.	Food Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1–6, ...	6½	7	33½	8⅓	7½	16.3
6–12, ...	6½	7	29½	8	7	15.8
12–18, ...	6½	5⅓	34⅓	7⅔	7	14.9
18–31, ...	6½	5⅓	28	7	6½	14.1

The experiment with Clara was discontinued at the end of this month on account of her distaste for ensilage.

Analyses of Milk.

	May 3.	May 7.	May 12.	May 20.	May 23.	May 26.
Water, ...	87.25	87.39	87.20	87.69	87.88	87.97
Solids, ...	12.75	12.61	12.80	12.31	12.12	12.03
Fat (in solids), ...	3.68	3.62	3.66	3.47	3.21	3.47

Mean of three last stated Analyses of Milk.

Water, ...	87.85
Total solids, ...	12.15
Fat (in solids), ...	3.39

Melia (IV.) takes the place of Clara.

IV. — RECORD OF MELIA.

Ayrshire; 11 years old; dropped last calf Feb. 15, 1884.

[MELIA consumed larger quantities of ensilage, and has taken the place of III. (CLARA) in our previous feeding.]

	Feed Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	–	–	–	–	–	–	–	–	–
2, . .	–	–	–	–	–	–	–	–	–
3, . .	6½	–	7	20	14	13½	27½	14.5	692½
4, . .	"	–	6	40	15	14½	29½	16.2	–
5, . .	"	–	5	40	14	14	28	15.3	–
6, . .	"	–	5	40	15	13½	28½	15.3	–
7, . .	"	–	6	40	14	13½	27½	16.2	–
8, . .	"	–	5	40	15½	12	27½	15.3	–
9, . .	"	6½	6	50	14	13	27	23.2	–
10, . .	"	"	5	58	14	12½	26½	23.4	–
11, . .	"	"	5	59	14½	13	27½	23.5	–
12, . .	"	"	5	60	15	12	27	23.6	–
13, . .	"	"	6	60	14½	12	26½	24.5	–
14, . .	"	"	5	60	14	13	27	23.6	–
15, . .	"	"	5	60	14	13	27	23.6	–
16, . .	"	"	5	60	14	14	28	23.6	–
17, . .	"	"	12	Discontinued; stock of ensilage exhausted.	13½	14	27½	22.1	755
18, . .	"	"	14		13	14	27	23.9	–
19, . .	"	"	12		13½	13	26½	22.1	–
20, . .	"	"	12		13½	13	26½	22.1	–
21, . .	"	"	12		14	12	26	22.1	–
22, . .	"	"	14		14	13	27	23.9	–
23, . .	"	"	14		13	13	26	23.9	–
24, . .	"	Discontinued.	*16		14	12	26	20.0	760
25, . .	"		*19		14	12	26	22.7	–
26, . .	"		*16		13	11½	24½	20.0	–
27, . .	"		*20		13	11	24	23.6	–
28, . .	"		*20		12	11	23	23.6	–
29, . .	"		*20		12	11	23	23.6	–
30, . .	"		*20		12	10½	22½	23.6	–

* New hay.

Analyses of Milk.

	June 16.	June 30.
Water, ...	87.84	88.29
Solids, ...	12.16	11.71
Fat (in solids), ...	3.21	2.99

SUMMARY OF OBSERVATIONS UNDER EXISTING CIRCUMSTANCES.

1. The cows differed widely in their preference for ensilage.

2. Reducing the ensilage to the same state of dryness noticed in the hay, we find that the total quantity of *dry vegetable matter* previously consumed has been considerably reduced, in consequence of the introduction of the ensilage. This is more apparent in Nos. II. and III., than in No. I.

3. The quantity of milk has, in every instance, increased, in consequence of the addition of ensilage to *our customary mode of feeding*, counting the amount of dry vegetable matter, in each case, pound for pound with the milk produced.

4. The increase in quantity of milk, counting on the basis of the total amount of fodder consumed, was most pronounced in case of moderate quantities of ensilage, i. e., from thirty-five to forty pounds per day.

5. The addition of a liberal amount of wheat shorts (bran) to the daily diet (9th of June), has, in most instances, but slightly affected the absolute yield of milk for the better; and has at no time changed the relative proportions between dry vegetable matter and the yield of milk, in favor of the former, as compared with the feeding of corn ensilage alone as an essential additional constituent of the original daily diet. The main benefit derived from the addition of wheat shorts to the daily fodder rations, consisted, evidently, in the improved appearance of the cows, in the improvement of the milk, and in an increased value of the manure resulting.

The quality of milk was not perceptibly changed, as far as the *density and the amount of fat was concerned*, with the exception, when a liberal amount of shorts were fed. None of the mean results obtained after feeding ensilage have been below the lowest results before its introduction in the daily diet.

In stating the composition of milk, only, with reference to water, solid matter and fat, it has been by no means assumed,— in following thereby the common usage,— that the information regarding these points suffices, under all circumstances, to establish the normal character of a sample of milk. The total amount and the relative proportions of the various nitrogenous constituents of the milk,— commonly stated by the collective name, casein,—are known to affect, at times, seriously its character.

Observations in that direction quite naturally suggest themselves in the course of our investigation. The results thus far obtained are, however, for various reasons beyond our control, not decisive enough to question, at the present stage of our work, seriously, the good quality of the milk obtained in connection with the feeding of a moderate amount of corn ensilage. The total amount of nitrogenous matter (crude casein) noticed in case of cow No. II. (May 11 and 26) differed but slightly in different samples as far as its absolute quantity and the relative proportions of casein, albumen and lactoprotein are concerned. The milk of cow No. I., the largest consumer of ensilage, showed a somewhat larger amount of total nitrogenous matter, as compared with that from cow No. II.; and the albumen and lactoprotein showed a marked increase. Whether these results will prove hereafter to be merely of an incidental character, or will have to be ascribed to an excessive consumption of ensilage, farther studies at the earliest suitable occasion are designed to show.

The financial side of the ensilage feeding is not discussed in this connection on account of the absence of exact figures regarding the cost of our ensilage.

The analyses of the various articles of fodder used in above stated feeding experiments, — corn ensilage, timothy hay, wheat shorts, and corn meal,— are as follows: —

ENSILAGE OF CORN IN TASSEL.

[Sample taken from Silo when opened, April 29th.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . . .	86.88	1,737.6	–	–	1 : 6.57
Dry Matter, ...	13.12	262.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	6.89	137.8	–	–	
" Cellulose, . . .	33.66	673.2	484.70	72	
" Fat, ...	3.88	77.6	58 20	75	
" Protein (Nitrogenous Matter), . . .	12.58	251.6	183 67	73	
Non-nitrogenous Extract Matter, ...	42.99	859.8	576.06	67	
	100.00	2,000.0	1,302.63	–	

The silo which furnished this ensilage has been described in the first Annual Report of the station. The fodder corn which filled the silo was well tasselled out, and had, a few days previously, suffered from a severe frost on the night of September 3d; it had been cut into pieces from two to three inches in length, before it had been tramped down, covered and subjected to a pressure of sixty pounds to a square foot of surface. The silo was opened for the use of its contents on April 29th. The color of the ensilage was dark yellowish green; it had an acid taste and odor. On the top of the mass and around its sides could be noticed, for some inches in thickness, some mould. The main bulk of the mass — judging from the opinion expressed by many visitors to the station, who claimed to be familiar with the usual appearance of corn ensilage — corresponded evidently with a large proportion of the ensilage fed during the past.

A comparison of the above stated analysis of the dried ensilage, with an analysis of the frost-bitten corn fodder collected at the time the silo was being filled, shows a decrease of non-nitrogenous constituents, except in the case of fat; and a decided increase in nitrogenous matter (crude protein). The nutritive properties of the corn fodder had been greatly modified in consequence of its treatment in the silo; its nutritive ratio (i. e., relation of nitrogen-containing food constituents to non-nitrogen-containing constituents) had been raised to that of our better grasses.

This result is not an exceptional one *in character;* it is only marked *in degree*, judging from well-endorsed observations in competent hands elsewhere, and is coöperated in the case of all kinds of ensilage. Yet these changes in quality are accompanied by a considerable destruction of valuable organic matter. The fact that the nitrogenous constituents (crude protein) resist better the destructive influences in the ordinary silo, than the non-nitrogenous plant constituents, as starch, sugar, cellulose, etc., is the real cause of the alteration in the nutritive character of the fodder, in consequence of our present management of the silo. An analysis of the liquid, which, under a partial pressure upon our ensilage, accumulated upon the cleaned floor of the silo, admits of no other explanation.

The investigation of the production of a good ensilage, together with a determination of cost as compared with hay, will be resumed at an early date.

Liquid of Ensilage taken from the Bottom of the Silo.

Specific gravity at 20° C., 1.025; 102.5 grams of solution required $\frac{1}{2}$ gram of carbonate of soda for its neutralization.

Moisture at 100° C.,	81.52
Dry matter,	18.38
	100.00

Analysis of Dry Matter.

Sesquioxide of iron,	.04
Calcium oxide,	.85
Magnesium oxide,	1.07
Phosphoric acid,	.20
Potassium oxide,	.81
Sodium oxide,	.16
Nitrogen,	.59

Of the nitrogen found in the liquid .246 parts was present in form of soluble albuminoids and .344 parts in form of ammonia compounds. The liquid contained from three to four per cent. more of solid matter than the original corn fodder.

CORN FODDER (Frost-bitten).

(IN TASSEL).

[From Experimental Plats of the Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.83	176.6	–	–	1 : 9.83
Dry Matter, ...	91.17	1,823.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	4.86	97.2	–	–	
" Cellulose, . . .	29.05	581.0	418.32	72	
" Fat, ...	2.06	41.2	30.90	75	
" Protein (Nitrogenous Matter), ...	8.63	172.6	126.00	73	
Non-nitrogenous Extract Matter, ...	55.40	1,108.0	742.36	67	
Total, ...	100.00	2,000.0	1,317 58	–	

This corn fodder served for the production of the previously described corn ensilage. Its frost-bitten condition, and *half matured stage of growth*, have, no doubt, seriously affected the quality and quantity of the ensilage.

TIMOTHY HAY.

[From the Experimental Farm, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.70	174.0	–	–	–
Dry Matter, ...	91.30	1,826.0	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash, ...	4.04	80.8	–	–	–
" Cellulose, . . .	36.59	731.8	–	–	–
" Fat, ...	2.12	42.4	–	–	–
" Protein (Nitrogenous Matter), ...	7.24	144.8	–	–	–
Non-nitrogenous Extract Matter, ...	50.01	1,000.2	–	–	–
Total, ...	100.00	2,000.0	–	–	–

The hay was harvested in July, after blooming. The sample was taken from the barn in November. The article can scarcely be called a fair average quality of its kind.

CORN MEAL.

[From John L. Holley, South Amherst, Mass.]

Ninety-two per cent. passing through mesh 144 to square inch.

	Percentage Composition.	Constituents (In lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.85	271.0	–	–	1 : 9.66
Dry Matter, ...	86.45	1,729.0	–	–	
Analysis of Dry Matter.	100.00	2,000.0	– –	–	
Crude Ash, ...	1.42	28.4	–	–	
" Cellulose, . . .	2.64	52.8	17.95	34	
" Fat, ...	4.24	84.4	64 45	76	
" Protein (Nitrogenous Matter), ...	10.40	208.0	176.80	85	
Non - nitrogenous Extract Matter, ...	81.30	1,626.0	1,528.44	94	
Total, ...	100.00	2,000 0	1,787.64	–	

A fair article of its kind.

WHEAT BRAN.

[From John L Holley, South Amherst, Mass.]

Thirty-three per cent. passed through mesh 144 to the square inch (May and June).

	Percentage Composition.	Constituents (In lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.08	241.6	–	–	1 : 4.16
Dry Matter, ...	87.92	1,758.4	–	–	
Analysis of Dry Matter.	100.00	2,000.0	–	–	
Crude Ash, ...	7.92	158.4	–	–	
" Cellulose, . . .	13.72	274.4	54.88	20	
" Fat, ...	3.81	76.2	60.96	80	
" Protein (Nitrogenous Matter), ...	15.67	313.4	275.79	88	
Non - nitrogenous Extract Matter, ...	58.88	1,177.6	942.08	80	
Total, ...	100.00	2,000.0	–	–	

This quality of wheat bran, which is of a fair composition, has been used in the previously described feeding experiments.

2. NOTES ON FEEDING EXPERIMENTS WITH GLUTEN MEAL AS A CONSTITUENT OF THE DAILY DIET OF MILCH COWS.

The experiment was instituted for the purpose of studying the effect of gluten meal as a constituent of the daily diet of milch cows, on the quantity and the quality of milk obtained, as well as on the cost of its production under several specified circumstances. The same cows which served in the previous trial with corn ensilage, Indian meal, wheat bran and hay, were used in that with gluten meal.

The observations extended over a period of three months. The third period of feeding was not extended beyond two weeks, on account of the bad influence of a too liberal supply of nitrogenous constituents in the daily diet, during very warm weather, on the general condition of the cows.

The mode of feeding was essentially the same as reported on previous occasions. The gluten meal was fed with an equal weight of wheat bran to compensate its deficiency in phosphates of lime and magnesia, and to render it more palatable. The designed amount of both substances was in each instance mixed and moistened, and fed in two meals during milking; the hay followed, mornings, noons and after milking evenings; care being taken to ascertain by weight, before and after meals the exact amount consumed.

The composition and the general character of the gluten meal is described in a few subsequent pages. The cost of the daily fodder rations used in these experiments, are based on our local market prices: gluten meal, $22.50; wheat bran, $23, and hay $15 per ton. Corn meal has cost, during our trials, $28 per ton. It has been the aim, in our subsequent statement of results, to render prominent the controlling influence of the daily yield of milk on its cost under a corresponding system of feeding. It will be noticed, in our trials, that under nearly identical conditions, as far as kind of fodder and period of milking are concerned, the milk of one cow, as compared with that of another one, may cost the owner of the animals from forty to ninety per cent. and more in one case than in the other. A careful comparison of the subsequent detailed statement of our late experiment with the previous one, tends to show that a good gluten meal. at the stated cost, ought to be considered a valuable addition to our commercial concentrated fodder articles. The rations fed during the first feeding period and at the close of the experiment (IV. Period), deserve from a standpoint, a trial on the part of dairymen. Our results were satisfactory as far as the yield of milk of a good quality is concerned.

I. — RECORD OF MELIA.

FEEDING (I.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
July 1-8, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	13	$12\frac{4}{7}$	$25\frac{4}{7}$	23.97	$782\frac{1}{2}$
8-15, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$14\frac{2}{7}$	13	$27\frac{2}{7}$	23.97	$782\frac{1}{2}$
15-22, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$13\frac{5}{7}$	$12\frac{5}{7}$	$26\frac{3}{7}$	23.97	$782\frac{1}{2}$
22-29, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$14\frac{1}{7}$	13	$27\frac{1}{7}$	23.97	$762\frac{1}{2}$
29-Aug. 5, .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$14\frac{3}{7}$	$13\frac{6}{7}$	$28\frac{2}{7}$	23.97	795

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 1ST PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
$113\frac{3}{4}$ lbs. Gluten Meal, .	100.46	26.44	62.15	3.40	1 : 6.32
$113\frac{3}{4}$ lbs. Shorts, . .	101.84	20.25	54.93	4.34	
700 lbs. Hay, . . .	626.15	35.99	358.64	8.53	
Total, ...	828.45	82.68	475.72	16.27	

Analyses of Milk.

	July 12.	July 22.	July 28.	Aug. 4.
Water,	88.15	87.30	87.40	87.92
Solids,	11.85	12.70	12.60	12.08
Fat (in solids),	3 28	3.14	3.48	3.20

Cost of Fodder Consumed during the 1st Feeding Period.

113¾ lbs. Gluten Meal,	$1 27
113¾ lbs. Shorts,	1 31
700 lbs. Hay,	5 25
Total, 927½ lbs.	$7 83

Daily produce of milk,	26.7 lbs., 13.36 qts.
Cost of daily fodder,	22.4 cents.
Cost of fodder per quart of milk,	1.68 cents.

Record of Melia — Continued.

FEEDING (2.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Aug. 5–12,	6½	3¼	$18\frac{4}{7}$	$14\frac{4}{7}$	$13\frac{3}{7}$	28	25.50	777
12–19,	6½	3¼	$19\frac{3}{7}$	15	13	28	26.33	782
19–26,	6½	3¼	$15\frac{6}{7}$	$13\frac{3}{7}$	$13\frac{5}{7}$	$27\frac{1}{7}$	23.10	795
26–Sept. 2,	6½	3¼	$19\frac{3}{7}$	14	$12\frac{2}{7}$	$26\frac{2}{7}$	26.33	827½

Amount of Digestible Matter contained in the Feed consumed.

AMOUNT OF FODDER CONSUMED DURING THE 2D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
182 lbs. Gluten Meal,	160.74	43.69	113.83	5.45	1 : 5.32
91 lbs. Shorts,	81.46	16.21	43.94	3.47	
517 lbs. Hay,	462.46	26.58	265.11	6 30	
Total,	704.66	86.48	422.88	15.22	

Analysis of Milk, Aug. 11.

Water, ...	87.15
Solids, ...	12.85
Fat (in solids), ...	3.49

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal, ...	$2 04
91 lbs. Shorts, ...	1 05
517 lbs. Hay, ...	3 88
Total, 790 lbs., ...	$6 97

Cost of fodder per day, ...	24.9 cents.
Average produce of milk per day, . . .	27.36 lbs., 13.68 quarts.
Cost of fodder per quart of milk, ...	1 82 cents.

Record of Melia — Continued.

FEEDING (3.)	FEED CONSUMED (LBS.) PER DAY			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 2–9, . .	$6\frac{1}{2}$	$6\frac{1}{2}$	$14\frac{2}{7}$	$14\frac{1}{7}$	12	$26\frac{1}{7}$	24.50	784
9–16, . .	$6\frac{1}{2}$	$6\frac{1}{2}$	$13\frac{5}{7}$	12	$10\frac{3}{7}$	$22\frac{3}{7}$	23.97	815

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 3D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal, .	80.37	21 85	56.92	2.73	1 : 4.42
91 lbs. Shorts, . . .	81.56	16.21	43.94	3 47	
196 lbs. Hay, . . .	175.32	10.08	100.30	2.39	
Total, ...	237.25	48 14	201.16	8.59	

Analysis of Milk, Sept. 10.

Water, ...	87 60
Solids, ...	12.40
Fat (in solids), ...	3.55

Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal,	$1 02
91 lbs. Shorts,	1 05
196 lbs. Hay,	1 47
Total, 378 lbs.,	$3 54

Cost of fodder per day,	25.3 cents.
Average produce of milk per day,	24.3 lbs., 12.15 quarts.
Cost of fodder per quart of milk,	2.08 cents.

Record of Melia — Concluded.

FEEDING (4.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 16-23,	3¼	3¼	19.4	12.86	11	23.86	23.42	845
23 to Oct. 1,	3¼	3¼	20.0	13.36	12	25.36	23.97	790

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 4TH PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45.5 lbs. Gluten Meal,	40.18	10.93	28.46	1.37	1 : 6.25
45.5 lbs. Shorts,	40.73	8.11	21.97	1.73	
276 lbs. Hay,	246.88	14.19	141.41	3.36	
Total,	327.79	33.23	191.84	6.46	

Analyses of Milk.

	Sept. 17.	Sept. 30.
Water,	87.48	87.56
Solids,	12.52	12.44
Fat (in solids),	3.26	3.14

Cost of Fodder consumed during the 4th Feeding Period.

45.5 lbs. Gluten Meal, ...	$0 51
45.5 lbs. Shorts, ...	52
276 lbs. Hay, ...	2 07
Total, 367 lbs., ...	$3 10

Cost of fodder per day, ...	22.14 cents.
Average production of milk per day, . . .	24.6 lbs., 12.32 quarts.
Cost of fodder per quart of milk, ...	1.8 cents.

II. — RECORD OF NELLIE MAY.

FEEDING (1.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
July 1–8, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$9\frac{5}{7}$	$9\frac{2}{7}$	19	23.97	925
8–15, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	10	$9\frac{1}{7}$	$19\frac{1}{7}$	23.97	917
15–22, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	10	$9\frac{1}{7}$	$19\frac{1}{7}$	23.97	900
22–29, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$9\frac{6}{7}$	$8\frac{3}{7}$	$18\frac{2}{7}$	23.97	892
29 to Aug. 5, .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$9\frac{4}{7}$	$8\frac{1}{7}$	$17\frac{5}{7}$	23.97	937

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 1ST PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
$113\frac{3}{4}$ lbs. Gluten Meal, .	100.46	26.44	62.15	3.40	1 : 6.32
$113\frac{3}{4}$ lbs. Shorts, . .	101.84	20.25	54.93	4.34	
700 lbs. Hay, . . .	626.15	35.99	358.64	8.53	
Total, ...	828.45	82.68	475.72	16.27	

Analyses of Milk.

	July 12.	July 22.	July 28.
Water,	87.11	86.73	86.49
Solids,	12.89	13.27	13.51
Fat (in solids),	3.86	3.61	4.01

Cost of Fodder consumed during the 1st Feeding Period.

113¾ lbs. Gluten Meal,	$1 27
113¾ lbs. Shorts,	1 31
700 lbs. Hay,	5 25
Total, 927½ lbs.,	$7 83
Daily produce of milk,	18.63 lbs., 931 quarts.
Cost of fodder per day,	22.4 cents.
Cost of fodder per quart of milk,	2.41 cents.

Record of Nellie May — Continued.

FEEDING (2.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Aug. 5–12,	6½	3¼	20	8 4/7	8	16 4/7	26.86	945
12–19,	6½	3¼	20	8 5/7	8	16 5/7	26.86	945
19–26,	6½	3¼	19 3/7	8	7	15	26.86	960
26 to Sept. 1,	6½	3¼	20	8 1/7	7 1/7	15 2/7	26.86	977

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 2D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
182 lbs. Gluten Meal,	160.74	43.69	113.83	5.45	1 : 5.45
91 lbs. Shorts,	81.46	16.21	43.94	3.47	
556 lbs. Hay,	497.34	28.59	284.86	6 78	
Total,	739.54	88.49	442.63	15.70	

Analyses of Milk.

	Aug. 5.	Aug. 11.
Water,	86.77	86.75
Solids,	13.23	13.25
Fat (in solids),	4.01	4.06

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal,	$2 04
91 lbs. Shorts,	1 05
556 lbs. Hay,	4 17
Total, 829 lbs.,	$7 26

Cost of fodder per day,	25.93 cents.
Average produce of milk per day,	15.9 lbs., or 7.95 quarts.
Cost of fodder per quart of milk,	3.38 cents.

Record of Nellie May — Continued.

FEEDING (3.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 2- 8,	$6\frac{1}{2}$	$6\frac{1}{2}$	$19\frac{1}{7}$	$8\frac{1}{7}$	$7\frac{5}{7}$	$15\frac{6}{7}$	28.95	955
8-15,	$6\frac{1}{2}$	$6\frac{1}{2}$	$18\frac{2}{7}$	$7\frac{3}{7}$	$6\frac{3}{7}$	$13\frac{6}{7}$	28.95	985

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 3D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal,	80.37	21.85	56.92	2.73	1 : 5.1
91 lbs. Shorts,	81.56	16.21	43.94	3.47	
270 lbs. Hay,	239.52	13.88	139.27	3.29	
Total,	401.45	51.94	240.13	9.49	

Analysis of Milk Sept. 10.

Water,	85.18
Solids,	14.82
Fat (in solids),	4.59

Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal,	$1 02
91 lbs. Shorts,	1 05
270 lbs. Hay,	2 03
Total, 452 lbs.	$4 10

Average produce of milk per day,	14.18 lbs., 7.09 quarts.
Cost of fodder per day,	29.3 cents.
Cost of fodder per quart of milk,	4.13 cents.

Record of Nellie May — Concluded.

FEEDING (4.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 15–22,	$3\frac{1}{4}$	$3\frac{1}{4}$	$17\frac{3}{7}$	$6\frac{4}{7}$	$5\frac{4}{7}$	$12\frac{1}{7}$	21.67	$1{,}002\frac{1}{2}$
22–29,	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$6\frac{6}{7}$	$6\frac{6}{7}$	$14\frac{2}{7}$	23.97	1,005

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 4TH PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45½ lbs. Gluten Meal,	40.18	10.93	28.46	1.37	1 : 6.11
45½ lbs. Shorts,	40.73	8.11	21.97	1.73	
274 lbs. Hay,	245.09	14.84	140.38	3.34	
Total,	326.00	33.88	190.81	6.44	

Analysis of Milk.

	Sept. 17.	Sept. 30.
Water, ...	85.04	85.92
Solids, ...	14.96	14.08
Fat (in solids), ...	4.36	4.45

Cost of Fodder consumed during the 4th Feeding Period.

45½ lbs. Gluten Meal, ...	$0 51
45½ lbs. Shorts, ...	52
274 lbs. Hay, ...	2 06
Total, 365 lbs., ...	$3 09

Average produce of milk per day, ...	13.46 lbs., 6.82 quarts.
Cost of fodder per day, ...	22.1 cents.
Cost of fodder per quart of milk, ...	3.25 cents.

III. — Record of Fairy.

FEEDING (1.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
July 1–8, . .	3¼	3¼	20	10 1/7	9 4/7	19 5/7	23.97	907
8–15, . .	3¼	3¼	20	10 6/7	10 1/7	21	23.97	927
15–22, . .	3¼	3¼	20	10 6/7	10	20 6/7	23.97	912½
22–29, . .	3¼	3¼	20	10 2/7	9 2/7	19 4/7	23.97	902
29–Aug. 4, .	3¼	3¼	20	10 1/7	9	19 1/7	23.97	935

Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 1ST PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
$113\frac{3}{4}$ lbs. Gluten Meal, .	100.46	26.44	62.15	3.40	1 : 6.32
$113\frac{3}{4}$ lbs. Shorts, . .	101.84	20.25	54.93	4.34	
700 lbs. Hay, . . .	626.15	35.99	358.64	8.53	
Total, ...	828.45	82.68	475.72	16.27	

Analyses of Milk.

	July 12.	July 22.	July 28.	Aug. 4.
Water, ...	87.05	86.42	86.82	86.79
Solids, ...	12.95	13.58	13.18	13.21
Fat (in solids), ...	3.76	3.73	3.67	3.81

Cost of Fodder consumed during the 1st Feeding Period.

$113\frac{3}{4}$ lbs. Gluten Meal, ...	$1 27
$113\frac{3}{4}$ lbs. Shorts, ...	1 31
700 lbs. Hay, ...	5 25
Total, $927\frac{1}{2}$ lbs., ...	$7 83
Average produce of milk per day, ...	20.1 lbs., 10 quarts.
Cost of fodder per day, ...	22.4 cents.
Cost of fodder per quart of milk, ...	2.24 cents

Record of Fairy — Continued.

FEEDING (2.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Aug. 4–11, . .	$6\frac{1}{2}$	$3\frac{1}{4}$	20	$10\frac{3}{7}$	$9\frac{4}{7}$	20	26.86	942
11–18, . .	$6\frac{1}{2}$	$3\frac{1}{4}$	20	$10\frac{5}{7}$	$9\frac{5}{7}$	$20\frac{3}{7}$	26.86	952
18–25, . .	$6\frac{1}{2}$	$3\frac{1}{4}$	$19\frac{3}{7}$	$9\frac{6}{7}$	9	$18\frac{6}{7}$	26.26	965
25–Sept. 1, .	$6\frac{1}{2}$	$3\frac{1}{4}$	$19\frac{5}{7}$	10	$8\frac{5}{7}$	$18\frac{5}{7}$	26.67	$1,027\frac{1}{2}$

Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 2D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates	Fat.	
182 lbs. Gluten Meal, .	160.74	43.69	113.83	5.45	1 : 5.45
91 lbs. Shorts, . . .	81.46	16.21	43.94	3.47	
554 lbs. Hay, . . .	495.55	28.48	283.83	6 75	
Total, ...	737.75	88.38	441.60	15.67	

Analysis of Milk, Sept. 11.

Water, ...	86.39
Solids, ...	13 61
Fat (in solids), ...	3.91

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal, ...	$2 04
91 lbs. Shorts, ...	1 05
554 lbs. Hay, ...	3 79
Total, 827 lbs., ...	$6 88

Average produce of milk per day, . . .	19.5 lbs., 9.75 quarts.
Cost of fodder per day, ...	24.6 cents.
Cost of fodder per quart of milk, ...	2.52 cents.

Record of Fairy — Continued.

FEEDING (3.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 1-8, . .	$6\frac{1}{2}$	$6\frac{1}{2}$	20	$9\frac{3}{7}$	$8\frac{4}{7}$	18	29.71	$1{,}002\frac{1}{2}$
8-15, . .	$6\frac{1}{2}$	$6\frac{1}{2}$	$16\frac{4}{7}$	$9\frac{1}{7}$	$7\frac{6}{7}$	17	26.65	1,000

Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 3D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal, .	80.37	21.85	56.92	2.73	1 : 4.96
91 lbs. Shorts, . .	81.56	16.21	43.49	3.47	
251 lbs. Hay, . . .	224.52	12.90	128 59	3.06	
Total, ...	386.45	50.96	229 45	9.26	

Analysis of Milk Sept. 10.

Water, ...	85.60
Solids, ...	1.05
Fat (in solids), ...	1.88

Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal, ...	$1 02
91 lbs. Shorts	1 05
251 lbs. Hay, ...	1 88
Total, 433 lbs., ...	$3 95

Average produce of milk per day, . . .	14.68 lbs., 7.34 quarts.
Cost of fodder per day, ...	28.2 cents.
Cost of fodder per quart of milk, ...	3.84 cents.

Record of Fairy— Concluded.

FEEDING (4.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 15–22, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	$17\frac{5}{7}$	$9\frac{5}{7}$	$8\frac{5}{7}$	$18\frac{3}{7}$	21.96	$1,007\frac{1}{2}$
22–29, . .	$3\frac{1}{4}$	$3\frac{1}{4}$	20	10	9	19	23.97	1,035

Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 4TH PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45½ lbs. Gluten Meal, .	40.18	10.93	28.46	1 37	1 : 6.21
45½ lbs. Shorts, . .	40.73	8.11	21.97	1.73	
269 lbs. Hay, . . .	240.62	13.83	137.81	3.28	
Total, ...	321.53	32.87	188.24	6.38	

Analysis of Milk.

	Sept. 17.	Sept. 30.
Water, ...	85.85	85.99
Solids, ...	14.15	14.01
Fat (in solids), ...	4.06	4.11

Cost of Fodder Consumed during the 4th Feeding Period.

45½ lbs. Gluten Meal, ...	$0 51
45½ lbs. Shorts, ...	52
269 lbs. Hay, ...	2 02
Total, 360 lbs., ...	$3 05

Average produce of milk per day, . . .	18.9 lbs., 9.45 quarts.
Cost of fodder per day, ...	21.8 cents.
Cost of fodder per quart of milk, ...	2.31 cents.

GLUTEN MEAL.

[From Chicago Sugar Refining Company.]

Eighty-five per cent. passsed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.68	233.6	–	–	1 : 2.92
Dry Matter,	88.32	1,766 4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.79	15.8	–	–	
" Cellulose,	0.77	15.4	5.24	34	
" Fat,	3.94	78.8	59.89	76	
" Protein (Nitrogenous Matter),	28.24	564.8	408.08	85	
Non-nitrogenous Extract Matter,	66.26	1,325.2	1,245.69	94	
	100.00	2,000.0	1,790.90	–	

The gluten meal is obtained as a by-product in the manufacture of starch and glucose from corn. It consists mainly of the germs of the latter, with more or less skin parts and starch. The supply of this substance has acquired considerable proportions in consequence of the recent development of the glucose industry in this country.

Examinations of samples from various sources have demonstrated its highly nitrogenous character, and left but little doubt about its value for feeding purposes under suitable circumstances. For details in this direction I refer, as far as my own observations and statements are concerned, to Bulletin I., page 11, and Bulletin V., page 5, or the First Annual Report. The variations noticed in composition are in the main evidently caused by modifications in the manufacturing process, — a circumstance by no means an exceptional one, as far as the gluten meal is concerned; for all our valuable refuse materials for fodder, as brans, oil-cakes, etc., suffer from the same influence. The sample which served for our feeding experiments, and furnished the material for the above analysis, was obtained by the following process, according to the kind communication of Dr. A. Behr, the superintendent of the Chicago Sugar Refining Company: "The process mostly followed in starch and glucose works for the separation of starch, includes the use of caustic-soda for dissolving the gluten (nitrogenous constituents of the corn). Our process differs in these particulars, that we do not use any caustic-soda at all, and that we separate the germs of the corn before it is finally ground up. The consequence is, that gluten meal contains no caustic-soda or sodium-salts, and is comparatively poor in fat,—this being for the greater part removed with the germs. The way we proceed is briefly as follows: The water as it comes from the mills and carries the fine starch and gluten in suspension, is run over long slightly inclined troughs, the ordinary "Starch-Tables." Here the heavy starch settles, while the lighter particles, small starch, gluten, fibre and fat are carried away with the water. This mixture is allowed to settle in large vats, the clear water drawn off, and the residue dumped into filter presses. The press cakes are dried in steam driers, ground up in mills, and in this form make the gluten meal."

The calculation of the digestible portion of the gluten-meal is based on that noticed in corn-meal, in actual feeding tests. The numerical relations between the digestible amount of nitrogenous constituents and of carbohydrates or non-nitrogenous constituents in the above sample of gluten meal (1 : 2.92), corresponds quite closely with that in a fair sample of pease; its mineral constituents are, however, but one-fifth of that of the latter.

The article is offered for sale by the carload in bulk at $21 per ton, or $22.50 in bags, at Boston railroad depots; similar charges have been made in Springfield.

The analyses of Wheat Bran and Timothy Hay, below stated, refer to the materials used in this experiment.

WHEAT BRAN.

[From JOHN L. HOLLEY, South Amherst, Mass.]

13.71 per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.48	209.6	–	–	1 : 3.25
Dry Matter,	89.52	1,790.4	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.98	139.6	–	–	
" Cellulose,	10.20	204.0	40.80	20	
" Fat,	4.77	95.4	76.32	80	
" Protein (Nitrogenous Matter,	20.24	404.8	356.22	88	
Non-nitrogenous Extract Matter,	57.81	1,156.2	924.96	80	
	100.00	2,000.0	1,398.3	–	

The article sold at $23 per ton at the mill.

TIMOTHY HAY.

[From the grounds of the Experiment Station, June 20, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.55	211.0	–	–	1 : 10.6
Dry Matter,	89.45	1,789.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.69	93.8	–	–	
" Cellulose,	29.21	584.2	338.84	58	
" Fat,	2.65	53.0	24.38	46	
" Protein (Nitrogenous Matter,	9.02	180.4	102.83	57	
Non-nitrogenous Extract Matter,	54.43	1,088.6	685.82	63	
	100.00	2,000.0	1,151.87	–	

The grass was cut at the close of the blooming period, and the hay is a fair article of its kind.

SUMMARY OF THE INFLUENCE OF FEED ON THE COMPOSITION OF MILK.

NELLIE MAY. — Breed, grade Ayrshire; age, 4 years; dropped last calf Feb. 1, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk.			
			Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
April 8,	4 qts. Indian meal and hay all she would eat.	15 lbs.	87.57	12.43	3.71	8.72
11,		15 "	87.18	12.82	3.82	9.00
14,		15 "	87.09	12.91	3.87	9.04
16,	5¼ lbs. meal and 15 lbs. hay, .	14 "	87.33	12.67	3.56	9.11
18,	6½ lbs. meal and 17 lbs. hay, .	14 "	87.65	12.35	3.97	8.38
21,		14 "	87.02	12.98	3.99	8.99
May 3,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	16 "	87.00	13.00	3.81	8.19
7,		16 "	87.09	12.91	3.91	9.00
12,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	15 "	87.43	12.57	3.86	8.71
20,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.39	12.61	3.80	8.81
23,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.19	12.81	3.68	9.13
26,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.37	12.63	3.68	8.95
June 16,	6½ lbs. meal, 8 lbs. hay 6½ lbs. shorts and 40 lbs. ensilage.	20 "	86.89	13.11	3.81	9.30
30,	6½ lbs. meal and 20 lbs. hay, .	18 "	87.20	12.80	3.83	8 97
July 12,	3¼ lbs. wheat shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	19 "	87.11	12.89	3.86	9.03
22,		19 "	86.73	13.27	3.61	9.56
28,		18 "	86.49	13.51	4.01	9.50
Aug. 4,	3¼ lbs. wheat shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	17½ "	86.77	13.23	4.01	9.22
11,	3¼ lbs. wheat shorts, 6½ lbs. gluten meal and 20 lbs. hay.	17 "	86.75	13.25	4.06	9.19
Sept. 10,	6½ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	15 "	85.18	14.82	4.59	10.23
17,	3¼ lbs. shorts, 3½ lbs. gluten meal and 20 lbs. hay.	12 "	85.04	14.96	4.36	10.60
30,		14 "	85.92	14.08	4.45	9.63

FAIRY. — Breed, grade Ayrshire; age, 5 years; dropped last calf Feb. 25, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
April 8,	4 qts. meal and all hay animal would eat.	19 lbs.	87.46	12.54	3 33	9.21
11,		19 "	87.67	12.33	3.20	9.13
14,	4 qts. meal and all hay animal would eat.	19 "	87.54	12.46	3.34	9.12
16,	5½ lbs. meal and 15 lbs. hay, .	19 "	87.28	12.72	3.49	9.23
18,	6½ lbs. meal and 17 lbs. hay, .	19 "	87.92	12.08	3.32	8.76
21,	6½ lbs. meal and 17 lbs. hay, .	19 "	87.59	12.41	3.64	8.77
May 3,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	19 "	87.16	12.84	4 08	8.76
7,		19 "	86.99	13.01	3.88	9.13
12,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	19 "	86.84	13.16	3.93	9.13
20,	6½ lbs. meal, 7 lbs. hay and 60 lbs. ensilage.	19 "	87.33	12.67	3.60	9.07
23,		19 "	87.55	12.45	3.29	9.16
26,	6½ lbs. meal, 7 lbs. hay and 60 lbs. ensilage.	18½ "	87.57	12.43	3.37	9.06
June 10,	6½ lbs. corn meal, 6½ lbs. shorts, 7 lbs. hay and 60 lbs. ensilage.	20 "	87.10	12.90	3.61	9.29
16,		21 "	86.60	13.40	3.83	9.57
30,	6½ lbs. meal and 20 lbs. hay, .	20 "	87.36	12.64	3.59	9.05

FAIRY — *Concluded.*

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk.			
			Water.	Total Solids.	Fat.	Solids not Fat.
July 12,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	21 “	87.05	12.95	3.76	9.19
22,		21 “	86.42	13.58	3.73	9.85
Aug. 4,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	19 “	86.79	13.21	3.81	9.40
11,	3¼ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	21 “	86.39	13.61	3.91	9.70
Sept. 10,	6½ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	17 “	85.60	14.40	4.84	9 56
30,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	19 “	85.99	14.01	4.11	9.90

CLARA. — Breed, grade Ayrshire; age, 5 years; dropped last calf Feb. 25, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
April 8,	4 qts. meal and all the hay the animal would eat.	16 lbs.	88.04	11.96	3.27	8 69
11,		16 “	87.32	12.68	3.48	9.20
14,	4 qts. meal and all the hay the animal would eat.	16 “	87.39	12.61	3.56	9.05
18,	6½ lbs. meal and 15 lbs. hay, .	17 “	87.08	12.92	3 89	9.03
21,	6½ lbs. meal and 15 lbs. hay, .	16 “	87 37	12.63	3 73	8.90
May 3,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	15½ “	87 25	12.75	3.69	9.06
7,		15½ “	87.39	12.61	3.62	8.99
12,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	15 “	87.20	12.80	3.66	9.14
20,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	14 “	87.69	12.31	3.47	8.84
23,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	14 “	87.88	12.12	3.21	8.91
26,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	13 “	87.97	12.03	3.47	8.56

MELIA. — Breed, Ayrshire; age, 11 years; dropped last calf Feb. 15, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
June 16,	6½ lbs. meal, 6½ lbs. shorts, 5 lbs. hay and 60 lbs. ensilage.	28 lbs.	87.84	12.16	3.21	8.95
30,	6½ lbs. meal and 20 lbs. hay, .	23 “	88.29	11.71	2.99	8 72
July 12,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 “	88.15	11.85	3.28	8.57
22,		27 “	87.30	12.70	3.14	8 56
28,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 “	87.40	12.69	3.48	9.12
Aug. 4,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 “	87.92	12.08	3.20	8.88
11,	3¼ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	29 “	87.15	12.85	3.49	9.36
Sept. 10,		24 “	87 60	12.40	3 55	8.85
17,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	22 “	87.48	12.52	3.26	9.26
30,		25 “	87.56	12.44	3.14	9.30
Nov. 18,	3¼ lbs. shorts, 3¼ lbs. meal and 20 lbs. hay.	19 “	87.66	12.34	3 39	8.95
24,		19 “	87.88	12.22	3.48	8.74
Dec. 5,	3¼ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 15 lbs. hay.	22 “	87.01	12.99	3.55	9 44
10,		22 “	87.27	12 73	3.49	9.24
17,		21 “	87.68	12.32	3 21	9.03
24,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	20 “	87.31	12.69	3.58	9.11
1885.						
Jan. 7,		16 “	87.49	12.51	3.66	8.85
15,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	16 “	88.09	11.91	3.33	8.58

BESSIE. — Breed, grade Jersey; age, 5 years; dropped last calf Oct. 17, 1884.

YEAR AND MONTH.	FEED.	Daily Yield of Milk.	COMPOSITION OF MILK.			
			Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
Nov. 18,	3¼ lbs. shorts, 3¼ lbs. meal and 16 lbs. hay.	29 lbs.	87.06	12.94	4.04	8.90
24,		21 "	87.91	13.09	3.86	9.13
Dec. 5,	3¼ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 16 lbs. hay.	29 "	86.18	13.82	4.02	9.80
10,		29 "	86.99	13.01	3.72	9.29
17,	3¼ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 16 lbs. hay.	28 "	87.41	12.59	3.32	9.27
24,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	27 "	85.36	14.64	4.75	9.89
1885.						
Jan. 7,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	24 "	87.26	12.74	3.73	9.01
15,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	23 "	87.29	12.71	3.91	8.80

LADY HORACE. — Grade Ayrshire; age, 5 years; dropped last calf Oct. 16, 1884.

1884.						
Nov. 18,	3¼ lbs. shorts, 3¼ lbs. meal and 16 lbs. hay.	29 lbs.	86 02	13 98	4.99	8.99
24,		28 "	87.15	12.85	3.65	9 20
Dec. 5,	3¼ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 20 lbs. hay.	33 "	85.12	14.88	5.10	9.78
10,		34 "	87.20	12.80	3.74	9.06
17,		31 "	87 26	12.74	3.86	8.88
24,	3¼ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	29 "	86.22	13.78	4.70	9.08
1885.						
Jan. 7,	3¼ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	24 "	87.41	12.59	3.64	8.95
15,	3¼ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	24 "	87.05	12.95	3.95	9.00

OBSERVATIONS WITH MILK.

I. *Influence of Temperature on Specific Gravity.*

Pure milk (Lady Horace): Water, 87.17 per cent.; solids, 12.83 per cent.; fat, 3.69 per cent.; solids not fat, 9.14 per cent.

Temperature,	8.5° C.	Sp. Gr.,	1.0350.	*Lactometer,	120.
“	11.5°	“	1.0344.	“	118.
“	14.°	“	1.0338.	“	116.
“	16.5°	“	1.0329.	“	113.
“	19.5°	“	1.0323.	“	111.
“	22.°	“	1.0317.	“	109.
“	24.°	“	1.0314.	“	108.
“	28.3°	“	1.0299.	“	103.
“	30.°	“	1.0293.	“	101.

Pure milk: Water, 87.26 per cent.; solids, 12.74 per cent.; fat, 3.89 per cent.; solids not fat, 8.85 per cent.

Temperature,	7.° C.	Sp. Gr.,	1.0353.	Lactometer,	121.
“	9.°	“	1.0353.	“	121.
“	10.°	“	1.0350.	“	120.
“	13.°	“	1.0338.	“	116.
“	14.°	“	1.0335.	“	115.
“	16.°	“	1.0332.	“	114.
“	17.°	“	1.0329.	“	113.
“	19.5°	“	1.0320.	“	110.
“	21.°	“	1.0314.	“	108.
“	23.°	“	1.0311.	“	107.

Pure milk: Water, 86.22 per cent.; solids, 13.78 per fat, 4.70 per cent.; solids not fat, 9.08 per cent.

Temperature,	3.° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
“	6.5°	“	1.0353.	“	121.
“	8.5°	“	1.0350.	“	120.
“	11.°	“	1.0347.	“	119.
“	13.5°	“	1.0340.	“	117.
“	16.2°	“	1.0329.	“	113.
“	19.8°	“	1.0320.	“	110.

* The lactometer used in these examinations is Mott's Lactometer, verified by Dr. H. A. Mott of New York City, N. Y.

Pure milk: Water, 87.41 per cent.; solids, 12.59 per cent.; fat, 3.64 per cent.; solids not fat, 8.95 per cent.

Temperature, 11.5° C.	Sp. Gr., 1.0356.	Lactometer, 122.
“ 13.6°	“ 1.0350.	“ 120.
“ 16.°	“ 1.0347.	“ 119.
“ 18.°	“ 1.0341.	“ 117.
“ 18.5°	“ 1.0338.	“ 116.

Pure milk: Water, 87.05 per cent.; solids, 12.95 per cent.; fat, 3.95 per cent.; solids not fat, 3.00 per cent.

Temperature, 12.5° C.	Sp. Gr., 1.0338.	Lactometer, 116.
“ 15.°	“ 1.0332.	“ 114.

Pure milk (Bessie): Water, 86.99 per cent.; solids, 13.1 per cent.; fat, 3.72 per cent.; solids not fat 9.29 per cent.

Temperature, 9.° C.	Sp. Gr., 1.0353.	Lactometer, 121.
“ 11.°	“ 1.0350.	“ 120.
“ 14.5°	“ 1.0341.	“ 117.
“ 17.°	“ 1.0335.	“ 115.
“ 19.5°	“ 1.0332.	“ 114.
“ 21.4°	“ 1.0323.	“ 111.
“ 24.9°	“ 1.0311.	“ 107.
“ 27.5°	“ 1.0299.	“ 103.
“ 30.°	“ 1.0293.	“ 101.

Water, 87.41 per cent.; solids, 12.59 per cent.; fat, 3.29 per cent.; solids not fat, 9.30 per cent.

Temperature, 5.° C.	Sp. Gr., 1.0365.	Lactometer, 125.
“ 8.5°	“ 1.0362.	“ 124.
“ 9.°	“ 1.0362.	“ 124.
“ 12.°	“ 1.0353.	“ 121.
“ 16.°	“ 1.0341.	“ 117.
“ 17.°	“ 1.0341.	“ 117.
“ 20.°	“ 1.0329.	“ 113.
“ 21.°	“ 1.0326.	“ 112.
“ 23.5°	“ 1.0317.	“ 109.

Water, 85.33 per cent.; solids, 14.67 per cent.; fat, 4.75 per cent.; solids not fat, 9.92 per cent.

Temperature, 1.8° C.	Sp. Gr., 1.0371.	Lactometer, 127.
“ 6.5°	“ 1.0365.	“ 125.
“ 9.°	“ 1.0365.	“ 125.
“ 11.°	“ 1.0362.	“ 124.
“ 13.5°	“ 1.0356.	“ 122.
“ 16.5°	“ 1.0344.	“ 118.
“ 19.5	“ 1.0329.	“ 113.

Water, 87.27 per cent.; solids, 12.73 per cent.; fat, 3.73 per cent.; solids not fat, 9.00 per cent.

Temperature, 11.5° C.	Sp. Gr., 1.0356.	Lactometer, 122.
" 14.9°	" 1.0350.	" 120.
" 16.5°	" 1.0344.	" 118.
" 18.°	" 1.0341.	" 117.

Water, 87.32 per cent.; solids, 12.68 per cent.; fat, 3.91 per cent.; solids not fat, 8.77 per cent.

Temperature, 13.5° C.	Sp. Gr., 1.0335.	Lactometer, 115.
" 15.°	" 1.0335.	" 115.

Pure milk (Melia): Water, 87.27 per cent.; solids, 12.73 per cent.; fat, 3.49 per cent.; solids not fat, 9.24 per cent.

Temperature, 9.° C.	Sp. Gr., 1.0341.	Lactometer, 117.
" 11.° C.	" 1.0338.	" 116.
" 14.8°	" 1.0332.	" 114.
" 18.°	" 1.0323.	" 111.
" 20.5°	" 1.0320.	" 110.
" 22.°	" 1.0320	" 110.
" 25.°	" 1.0308.	" 106.
" 27.°	" 1.0302.	" 104.
" 29.5°	" 1.0293.	" 101.

Water, 87.67 per cent.; solids, 12.33 per cent.; fat, 3.24 per cent.; solids not fat, 9.09 per cent.

Temperature, 5.° C.	Sp. Gr., 1.0356.	Lactometer, 122.
" 8.8°	" 1.0353.	" 121.
" 12.°	" 1.0341.	" 117.
" 14.°	" 1.0335.	" 115.
" 15.5°	" 1.0332.	" 114.
" 17.°	" 1.0329.	" 113.
" 19.5°	" 1.0317.	" 109.
" 20.5°	" 1.0314.	" 108.

Water, 87.31 per cent.; solids, 12.69 per cent.; fat, 3.57 per cent.; solids not fat, 9.12 per cent.

Temperature, 0.5° C.	Sp. Gr., 1.0356.	Lactometer, 122.
" 5.5°	" 1.0353.	" 121.
" 8.°	" 1.0350.	" 120.
" 10.°	" 1.0350.	" 120.
" 12.5°	" 1.0341.	" 117.
" 15.5°	" 1,0332.	" 114.
" 19.°	" 1.0317.	" 109.

Water, 87.32; per cent.; solids, 12.68 per cent; fat, 3.66 per cent.; solids not fat, 9.02 per cent.

Temperature, 12.° C.	Sp. Gr., 1.0332.	Lactometer, 114.
“ 14.°	“ 1.0329.	“ 113.
“ 16.5°	“ 1.0326.	“ 112.
“ 17.7°	“ 1.0323.	“ 111.

Water, 88.07 per cent.; solids, 11.93 per cent.; fat, 3.33 per cent.; solids not fat, 8.60 per cent.

Temperature, 13.° C.	Sp. Gr., 1.0311.	Lactometer, 107.
“ 15.°	“ 1.0311.	“ 107.

MIXED MILK FROM SEVERAL COWS.

I. Water, 87.50 per cent.; solids, 12.50 per cent.; fat, 3.43 per cent.; solids not fat, 9.07 per cent.

Temperature, 12.° C.	Sp. Gr., 1.0350.	Lactometer, 120.
“ 14.5°	“ 1.0347.	“ 119.
“ 15.5°	“ 1.0344.	“ 118.
“ 17.°	“ 1.0338.	“ 116.
“ 18.°	“ 1.0335.	“ 115.

II. Water, 85.70 per cent.; solids, 14.30 per cent.; fat, 4.90 per cent,; solids not fat, 9.40 per cent.

Temperature, 12.° C.	Sp. Gr., 1.0362.	Lactometer, 124.
“ 14.°	“ 1.0355.	“ 122.
“ 16.°	“ 1.0345.	“ 118.
“ 17.°	“ 1.0335.	“ 115.
“ 19.°	“ 1.0329.	“ 113.
“ 22.°	“ 1.0323.	“ 111.
“ 27.°	“ 1.0305.	“ 105.

III. Water, 86.50 per cent; solids, 13.50 per cent.; fat, 3.88 per cent.; solids not fat, 9.62 per cent.

Temperature, 11.7° C.	Sp. Gr., 1.0365.	Lactometer, 125.
“ 13.°	“ 1.0359.	“ 123.
“ 14.°	“ 1.0353.	“ 121.
“ 15.°	“ 1.0350.	“ 120.
“ 16.	“ 1.0347.	“ 119.
“ 18.°	“ 1.0343.	“ 118.
“ 19.2°	“ 1.0340.	“ 117.
“ 20.°	“ 1.0338.	“ 116.
“ 21.°	“ 1.0330.	“ 114.
“ 21.5°	“ 1.0330.	“ 114.

IV. Water, 85.90 per cent.; solids, 14.10 per cent.; fat, 4.65 per cent.; solids not fat, 9.45 per cent.

Temperature, 11.° C.	Sp. Gr., 1.0362.	Lactometer, 124.
“ 13.°	“ 1.0353.	“ 121.
“ 15.°	“ 1.0347.	“ 119.
“ 16.5°	“ 1.0343.	“ 118.
“ 19.°	“ 1.0332.	“ 114.
“ 21.°	“ 1.0328.	“ 113.
“ 22.°	“ 1.0323.	“ 111.
“ 25.°	“ 1.0317.	“ 109.

V. Water, 86.34 per cent.; solids, 13.66 per cent.; fat, 3.93 per cent.; solids not fat, 9.73 per cent.

Temperature, 11.° C.	Sp. Gr., 1.0371.	Lactometer, 127.
“ 13.5°	“ 1.0371.	“ 127.
“ 15.°	“ 1.0362.	“ 124.
“ 16.5°	“ 1.0356.	“ 122.
“ 18.°	“ 1.0353.	“ 121.
“ 21.°	“ 1.0341.	“ 117.
“ 23.°	“ 1.0335.	“ 115.
“ 25.°	“ 1.0326.	“ 112.

VI. Water, 84.87 per cent.; solids, 15.13 per cent.; fat, 5.49 per cent.; solids not fat, 9.64 per cent.

Temperature, 11.° C.	Sp. Gr., 1.0359.	Lactometer, 123.
“ 13.°	“ 1.0350.	“ 120.
“ 14.5°	“ 1.0347.	“ 119.
“ 17.°	“ 1.0338.	“ 116.
“ 18.5°	“ 1.0338.	“ 116.

PURE MILK (MASSACHUSETTS AGRICULTURAL COLLEGE).

Temperature, 21.° C.	Sp. Gr., 1.032.	Lactometer, 110.
“ 14.°	“ 1.033.	“ 114.
“ 10.°	“ 1.035.	“ 120.
“ 7.°	“ 1.0355.	“ 122.

Increasing temperature of same: —

Temperature, 14.° C.	Sp. Gr., 1.0345.	Lactometer, 116.
“ 19.°	“ 1.0330.	“ 114.
“ 21.°	“ 1.0325.	“ 112.

II. *Influence of Water on the Composition of Milk.*

Milk from Lady Horace: Water, 87.05 per cent.; solids, 12.95 per cent.; fat, 3.95 per cent.; solids not fat, 9.00 per cent.

Added water until the lactometer stood at 100 at 15° C., or 14.5 per cent.

Water,	88.89 per cent.
Solids,	11.11 “
Fat (in solids),	3.31 “
Solids not fat,	7.80 “

Milk from Bessie: Water, 87.29 per cent.; solids, 12.71 per cent.; fat, 3.91 per cent.; solids not fat, 8.80 per cent.

Added water until the lactometer stood at 100 at 15° C., or 15.4 per cent.

Water,	89.03 per cent.
Solids,	10.97 “
Fat (in solids),	3.31 “
Solids not fat,	7.66 “

Milk from Melia: Water, 88.09 per cent.; solids, 11.91 per cent.; fat, 3.33 per cent.; solids not fat, 7.58 per cent.

Added water until the lactometer stood at 100 at 15° C., or 8.7 per cent.

Water,	88.91 per cent.
Solids,	11.09 “
Fat,	3.12 “
Solids not fat,	7.97 “

Pure milk — 1.032 specific gravity at 21° C., 110° lactometer.

3⅔ per cent. of water added	21.° C.	1.0315 Sp. Gr., or	103 Lactometer.
6⅔ “ “ “	21.°	1.030 “	104 “
10 “ “ “	21.°	1.029 “	100 “
16⅔ “ “ “	21.°	1.027 “	94 “

III. *Influence of Skimming on the Specific Gravity of Milk.*

Fresh genuine milk stood at —

23.° C.	1.0300 Sp. Gr., or		104 Lactometer.	
19.°	1.0315	"	108	"
14.°	1.0320	"	110	"

After skimming: —

9.° C.	1.0360 Sp. Gr., or		124 Lactometer.	
18.°	1.0350	"	120	"
23.°	1.0350	"	120	"

3. Notes on Feeding Experiments with Pigs.

The experiment described in a few subsequent pages is the first of a series planned for the purpose of studying the comparative feeding value of skim-milk and of creamery buttermilk, in connection with corn meal for the production of pork. To secure a suitable basis for the work, it was decided to ascertain first the facts regarding the results of feeding equal measures of skim-milk and of buttermilk, with a corresponding weight of corn meal in both cases. The skim-milk was obtained from the dairy of the college and the station; the buttermilk from the factory of the Amherst Co-operative Creamery Association. The skim-milk was rated at two cents per gallon, and the creamery buttermilk 1.37 cents per gallon, — the contractor's price. Corn meal was bought at $28 per ton. Several analyses of both kinds of milk, and the mean of three analyses of the corn meal fed during the experiment, are stated further on.

The skim-milk contained about 2.5 per cent. more solid matter than the creamery buttermilk, a circumstance due, most likely, to the access of some water from the first washing of the butter.

Six pigs, from forty to fifty pounds in weight (Berkshires), secured from the college farm, were used for the experiment; three of them were fed with skim-milk and corn meal (Lot A), and three with creamery buttermilk and corn meal (Lot B). Each of the two lots consisted of one barrow and two sows; the former (III.) gave in both lots the best results. The animals were fed alike, in the following way:—One-third of the daily ration of milk was fed with one-half of the daily ration of corn meal at six o'clock, A. M.; one-third of the milk at twelve o'clock, M., without any meal; and the remaining third part of milk with one-half of the meal at six o'clock, P. M. Whenever the previous feed was consumed some hours before a succeeding feeding time, the amount of daily fodder was gradually increased. This rule of feeding was carried out during the entire trial and suffered only a temporary modification in consequence of a few short periods of very hot weather.

At the beginning of the experiment about two ounces of corn meal were fed for every quart of milk, and subsequently three ounces for every quart. This proportion of corn meal to milk produced better results in the case of buttermilk (Lot B) than in the case of skim-milk (Lot A), considering the larger amount of solid matter contained in the latter.

Nearly one-fourth of the solid matter noticed in the skim-milk shows no return of a proportionate increase in live weight, as will be found on comparing the subsequent detailed record. The total live weight and dressed weight of both lots of animals differ only two to four pounds from each other,—the buttermilk leading. The cost of fodder per pound of dressed pork produced, amounts in Lot A (skim-milk) to 5.8 cents, and in case of Lot B (buttermilk) to 4.6 cents.

This difference in cost corresponds quite closely with the difference in cost of the two kinds of milk. The dressed pork was sold at 7½ cents per pound. The value of manure produced will be reported on some later occasion, when actual values can be presented.

The investigation is continued. Two breeds—Berkshire and Chester—are already on trial to turn to account the information received in the first experiment.

[A.]

SKIM-MILK AND CORN MEAL.

I.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts)		
May 21–31, ...	100	58	41½	0 lbs. 11 ozs.
June 1–9, ...	132	54	60½	1 " 0 "
9–17, ...	128	48	67	0 " 15 "
17–24, ...	152	50	79¾	1 " 13 "
24–30, ...	160	54	89¾	1 " 7 "
July 1–7, ...	210	70	101	1 " 10 "
7–14, ...	210	70	111½	1 " 8 "
14–22, ...	288	96	124¾	1 " 14 "
22–29, ...	252	84	140¾	2 " 4 "
29–Aug. 5, ...	228	76	147¾	1 " 0 "
Aug. 5–12, ...	180	60	156½	1 " 5 "
12–19, ...	252	84	170	1 " 15 "
19–26, ...	252	84	183½	1 " 15 "
26–Sept. 2, ...	258	86	188¼	0 " 11 "
Sept. 2–9, ...	231	77	202¼	2 " 0 "
9–16, ...	294	98	217¼	2 " $2\frac{2}{7}$ "
16–22, ...	210	70	228¾	1 " 15 "

Total amount of feed consumed from May 21 to Sept. 22, 1884,—

221 lbs. Corn Meal, equal to dry matter, ...	189.57 lbs.
1,219 qts. Skim-milk, equal to dry matter, ...	255 45 lbs.
Total amount of dry matter, ...	454.02 lbs.

Live weight of animal at beginning of experiment, . .	44.75 lbs.
Live weight at time of killing, ...	228.75 lbs.
Live weight gained during experiment, ...	184. lbs.
Dressed weight at time of killing, ...	181.75 lbs.
Loss in weight by dressing, ...	47 lbs., or 20.5 per cent.
Dressed weight gained during experiment, ...	146. lbs.

Cost of feed consumed during the experiment,—

221 lbs. Corn Meal, at 1.4 cents, ...	$3 09
305 gals. Skim-milk, at 2 cents per gal., ...	6 10
	$9 19

454 lbs. of dry matter fed, produced 184 lbs. of live weight, and 146 lbs. of dressed weight. 2.47 of dry matter yielded 1 lb. live weight; and 3.11 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 6.3 cents.

[A.]

Skim-milk and Corn Meal — Continued.

II.

Periods.	Feed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts.)		
May 21-31, ...	100	58	54½	0 lbs. 12 ozs.
June 1-9, ...	132	54	77	1 “ 11 “
9-17, . . .	192	64	87¼	1 “ 7 “
17-24, ...	152	50	97¾	1 “ 8 “
24-30, ...	160	54	109	1 “ 10 “
July 1-7, ...	210	70	121¼	1 “ 12 “
7-14, ...	210	70	130¾	1 “ 6 “
14-22, ...	288	96	141 8/4	1 “ 9 “
22-29, ...	252	84	154½	1 “ 13 “
29-Aug. 5, . . .	228	76	162¾	1 “ 3 “
Aug. 5-12, ...	180	60	167¼	0 “ 10 “
12-19, ...	252	84	179	1 “ 11 “
19-26, ...	252	84	190¾	1 “ 11 “
26-Sept. 2, . . .	258	86	193⅓	0 “ 7 “
Sept. 2-9, ...	294	98	211½	2 “ 8 “
9-16, ...	294	98	221¾	1 “ 8 “
16-22, ...	210	70	230¼	1 “ 7 “

Total amount of feed consumed from May 21 to Sept. 22, —

226½ lbs. Corn Meal, equal to dry matter, ...	197.92 lbs.
1,256 qts. Skim-milk, equal to dry matter, ...	263.21 lbs.
Total amount of dry matter, ...	461.13 lbs.
Live weight of animal at beginning of experiment, . .	54.50 lbs.
Live weight at time of killing, ...	230.25 lbs.
Live weight gained during experiment, ...	175.75 lbs.
Dressed weight at time of killing, ...	195. lbs.
Loss in weight by dressing, ...	35.25 lbs., or 15.3 per cent.
Dressed weight gained during experiment, ...	148.84 lbs.

Cost of feed consumed during the experiment, —

226½ lbs. Corn Meal, at 1.4 cents per lb., ...	$3 17
314 gals. Skim-milk, at 2 cents per gal., ...	6 28
	$9 45

461 lbs. of dry matter fed, produced 175.75 lbs. of live weight; and 148.84 lbs. of dressed weight. 263 lbs. of dry matter yielded 1 lb. live weight; and 3.08 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of pork, 6.4 cents.

[A]

SKIM MILK AND CORN MEAL — Concluded.

III.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts.)		
May 21–31,	100	58	50½	0 lbs. 15 ozs.
June 1–9,	132	54	74½	1 " 12 "
9–17,	192	64	85¾	1 " 10 "
17–24,	195	65	97¾	1 " 11 "
24–30,	195	65	114	2 " 5 "
July 1–7,	210	70	127¼	1 " 14 "
7–14,	252	84	145¼	2 " 9 "
14–22,	294	98	163	2 " 8 "
22–29,	294	98	181	2 " 9 "
29–Aug. 5,	294	98	200¾	2 " 13 "
Aug. 5–12,	294	98	214½	1 " 15 "
12–19,	294	98	236	3 " 1 "
19–26,	294	98	250½	2 " 1 "
26–Sept. 2,	300	100	257½	1 " 0 "
Sept. 2–9,	336	112	281¾	3 " 9 "
9–16,	336	112	293¾	1 " 12 "
16–22,	240	80	308½	2 " 7 "

Total amount of feed consumed from May 21 to Sept. 22,—

265¾ lbs. Corn Meal, equal to dry matter,	231.78 lbs.
1,452 qts. Skim-milk, equal to dry matter,	304.29 lbs.
Total amount of dry matter,	536.07 lbs.

Live weight at beginning of experiment,	50.50 lbs.
Live weight at time of killing,	308.50 lbs.
Live weight gained during experiment,	258. lbs.
Dressed weight at time of killing,	257.25 lbs.
Loss in weight by dressing,	51.25 lbs., or 16.64 per cent.
Dressed weight gained during experiment,	215.15 lbs.

Cost of feed consumed during experiment,—

265¾ lbs. Corn Meal, at 1.4 cents per lb.,	$3 72
363 gals. Skim-milk, at 2 cents per gal.,	7 26
	$10 98

536 lbs. of dry matter fed, produced 258 lbs. of live weight, and 215.15 lbs. dressed weight. 2.8 lbs. of dry matter yielded 1 lb. of live weight; and 2.5 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of pork, 5.11 cents.

[B]

BUTTERMILK AND CORN MEAL.

I.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
May 21-31, ...	100	58	48¼	0 lbs. 11 ozs.
June 1-9, ...	132	54	66	1 " 6 "
9-17, ...	192	64	77½	1 " 7 "
17-24, ...	152	50	87½	1 " 7 "
24-30, ...	160	54	98½	1 " 9 "
July 1-7, ...	210	70	107¾	1 " 5 "
7-14, ...	210	70	120¾	1 " 14 "
14-22, ...	288	96	131½	1 " 8 "
22-29, ...	252	84	143¾	1 " 12 "
29-Aug. 5, ...	192	68	153¾	1 " 7 "
Aug. 5-12, ...	168	56	160¾	1 " 0 "
12-19, ...	252	84	172½	1 " 11 "
19-26, ...	252	84	183¼	1 " 8 "
26-Sept. 2, ...	258	86	185	0 " 4 "
Sept. 2-9, ...	294	98	206¼	3 " 0 "
9-16, ...	294	98	219¼	1 " 14 "
16-22, ...	294	70	230½	1 " 14 "

Total amount of feed consumed from May 21 to Sept. 22, —

226 lbs. Corn Meal, equal to dry matter, ...	197.48 lbs.
1,244 qts. Buttermilk, equal to dry matter, ...	190.33 lbs.
Total amount of dry matter, ...	387.81 lbs.

Live weight of animal at beginning of experiment, . .	48.25 lbs.
Live weight at time of killing, ...	230.50 lbs.
Live weight gained during the experiment, ...	182.25 lbs,
Dressed weight at time of killing, ...	190.75 lbs.
Loss in weight by dressing, ...	39.75 lbs., or 17.3 per cent
Dressed weight gained during experiment, . .	150.85 lbs.

Cost of fodder consumed during experiment, —

226 lbs. Corn Meal, at 1.4 cents per lb., ...	$3 16
311 gals. Buttermilk, at 1.37 cents per gal., ...	4 26
	$7 42

387.8 lbs. of dry matter fed, produced 182.25 lbs. of live weight, and 150.85 lbs. of dressed weight. 2.12 lbs. of dry matter yielded 1 lb. of live weight; and 2.57 lbs. of dry matter yielded 1 lb. of dressed weight

Cost of feed for production of 1 lb. of pork, 4.92 cents.

[B.]

Buttermilk and Corn Meal — Continued.

II.

PERIODS.	Feed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
May 21–31,	100	58	45½	0 lbs. 12 ozs.
June 1–9,	132	54	67½	1 " 7 "
9–17,	192	64	79½	1 " 11 "
17–24,	152	50	89¾	1 " 6 "
24–30,	160	54	100	1 " 7 "
July 1–7,	210	70	111	1 " 9 "
7–14,	210	70	123¾	1 " 3 "
14–22,	288	96	135½	1 " 11 "
22–29,	252	84	147¼	1 " 11 "
29–Aug. 5,	192	68	158	1 " 8 "
Aug. 5–12,	168	56	163¾	0 " 13 "
12–19,	252	84	177	1 " 14 "
19–26,	252	84	189½	1 " 12 "
26–Sept. 2,	258	86	189	0 " 1⅐ "
Sept. 2–9,	294	98	211¾	3 " 4 "
9–16,	294	98	226¼	2 " 1 "
16–22,	210	70	238	1 " 15 "

Total amount of feed consumed from May 21 to Sept. 22, —

226 lbs. Corn Meal, equal to dry matter,	197.48 lbs.
1,244 qts. Buttermilk, equal to dry matter,	190.33 lbs.
Total amount of dry matter,	387.81 lbs.

Live weight of animal at beginning of experiment,	45.50 lbs.
Live weight at time of killing,	238. lbs.
Live weight gained during experiment,	192.50 lbs.
Dressed weight at time of killing,	199.25 lbs.
Loss in weight by dressing,	38.75 lbs., or 16.3 per cent.
Dressed weight gained during experiment,	161.2 lbs.

Cost of feed consumed during the experiment, —

226 lbs. Corn Meal, at 1.4 cents per lb.,	$3 16
311 gals. Buttermilk, at 1.37 cents per gal.,	4 26
	$7 42

387.8 lbs. of dry matter fed, produced 192.50 lbs live weight, and 161.2 lbs. dressed weight. 2.01 lbs. dry matter yielded 1 lb. of live weight; and 2.4 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb of pork, 4.64 cents.

[B.]

BUTTERMILK AND CORN MEAL — Concluded.

III.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
May 21–31,	100	58	49	0 lbs. 11 ozs.
June 1–9,	132	54	72	1 " 10 "
9–17,	192	64	85¼	1 " 14 "
17–24,	195	65	98	1 " 13 "
24–30,	195	65	109¼	1 " 10 "
July 1–7,	210	70	121¾	1 " 12 "
7–14,	252	84	133¼	1 " 10 "
14–22,	294	98	151½	2 " 10 "
22–29,	294	98	167	2 " 3 "
29–Aug. 5,	294	98	186¼	2 " 12 "
Aug. 5–12,	294	98	199¾	1 " 15 "
12–19,	294	98	218½	2 " 11 "
19–26,	294	98	227¾	1 " 5 "
26–Sept. 2,	300	100	233½	0 " 13 "
Sept. 2–9,	336	112	259	3 " 11 "
9–16,	336	112	281	3 " 2 "
16–22,	240	80	293¼	2 " 1 "

Total amount of feed consumed from May 21 to Sept. 22,—

265¾ lbs. Corn Meal, equal to dry matter,	232.21 lbs.
1,452 qts. Buttermilk, equal to dry matter,	222.16 lbs.
Total amount of dry matter,	454.37 lbs.

Live weight of animal at beginning of experiment,	49 lbs.
Live weight at time of killing,	293¼ lbs.
Live weight gained during experiment,	244¼ lbs.
Dressed weight at time of killing,	243 lbs.
Loss in weight by dressing,	50 lbs., or 17 per cent.
Dressed weight gained during experiment,	202.3 lbs.

Cost of feed consumed during the experiment,—

265¾ lbs. Corn Meal at 1.4 cents per lb.,	$3 72
363 gals. Buttermilk, at 1.37 cents per gal.,	4 98
	$8 70

454.37 lbs. of dry matter fed, produced 244¼ lbs. of live weight, and 202.3 lbs. dressed weight. 1.86 lbs. of dry matter yielded 1 lb. of live weight; and 2.23 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of pork, 4.3 cents.

SUMMARY OF RESULTS OF EXPERIMENTS.

A.—Pigs Fed with Skim-milk and Corn Meal.

	Corn Meal, in Pounds.	Skim-milk, in Gallons.	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.
I., ...	221	305	184	146
II., ...	226½	314	175¾	148⅘
III., ...	265¾	363	258	215⅕
	713¼	982	617¾	510

B.—Pigs Fed with Creamery Buttermilk and Corn Meal.

	Corn Meal, in Pounds.	Buttermilk, in Gallons.	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.
I., ...	226	311	182¼	150 9/10
II., ...	226	311	192½	161 2/10
III., ...	265¾	363	244¼	202 3/10
	717¾	985	619	514 4/10

Total Cost of Feed consumed during the Experiment.

A.	713¼ lbs. Corn Meal, ...	$9 98
	982 gals. Skim-milk, ...	19 64
		$29 62
B.	717¾ lbs. Corn Meal, ...	$10 04
	985 gals. Buttermilk, ...	13 50
		$23 54

Cost of Feed per Pound of Dressed Pork produced.

A.	Skim-milk and Meal, ...	5.8 cents.
B.	Buttermilk and Meal, ...	4.6 cents.

The difference in cost is approximately equal to the difference in cost of the buttermilk and skim-milk.

Analyses of Milk used in the Experiment.

SKIM-MILK.

[From the College and Experiment Station Farms.]

	I.	II.	III.	Mean.
Water, ...	90.20	90.42	90.64	90.42
Solids, ...	9.80	9.58	9.36	9.58
Fat (in solids), . .	.68	.32	.18	.39
Casein (nitrogenous matter, in solids), . .	–	3.23	–	3.23

Nutritive Ratio, 1 : 2.15.

These analyses represent the kind of skim-milk fed during the previously described feeding experiment. One quart weighed 35 ounces and contained 3.35 ounces of solid (dried) matter.

BUTTERMILK.

[From the Amherst Co-operative Creamery Association.]

	I.	II.	III.	Mean.
Water, ...	92 79	92.76	93.17	90.90
Solids, ...	7.21	7.25	6.83	7.09
Fat (in solids), . .	.20	.22	–	.21
Casein (nitrogenous matter, in solids), . .	–	2.90	–	2.90

Nutritive Ratio, 1 : 1.63.

These analyses were made at the same date when the skim-milk tests were carried out, and represent, as far as practicable, the quality of buttermilk fed during the above-described feeding trial.

One quart of buttermilk weighed 34 ounces and contained 2.41 ounces of solid matter (dried).

CORN MEAL.

[92.34 per cent. passed through mesh 144 to the square inch.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.4	–	–	1 : 8.68
Dry Matter,	87.38	1,747.6	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.2	–	–	
" Cellulose,	2.65	53.0	18.06	34	
" Fat,	4.27	85.4	64.90	76	
" Protein (Nitrogenous Matter),	11.43	228.6	194.31	85	
Non-nitrogenous Extract Matter,	80.09	1,601.8	1,505.69	94	
	100.00	2,000.0	1,782.96	–	

This article represents the average composition of the corn meal fed in connection with skim-milk and buttermilk in the feeding experiments with pigs, described in the previous pages.

WHEAT BRAN.

[From John L. Holley, South Amherst, Mass.; 13.71 per cent. passed through mesh 144 to the square inch.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.48	209.6	–	–	1 : 3.25
Dry Matter,	89.52	1,790.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.98	139.6			
" Cellulose,	10.20	204.0	40.80	20	
" Fat,	4.77	95.4	76.32	80	
" Protein (Nitrogenous Matter),	20.24	404.8	356.22	88	
Non-nitrogenous Extract Matter,	57.81	1,156.2	924.96	80	
	100.00	2,000.0	1,398.30	–	

The wheat bran of the previous table sold at $23 at the mill. This quality of wheat bran was fed during the gluten-meal feeding experiment with milch cows.

TIMOTHY HAY.

[From the grounds of the Experiment Station, June 20, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.55	211.0	–	–	1 : 10.6
Dry Matter,	89.45	1,789.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.69	93.8	–	–	
" Cellulose,	29.21	584.2	338.84	58	
" Fat,	2.65	53.0	24.38	46	
" Protein (Nitrogenous Matter),	9.02	180.4	102.83	57	
Non-nitrogenous Extract Matter,	54.43	1,088.6	685.82	63	
	100.00	2,000.0	1,151.87	–	

The grass was cut at the close of the blooming period, and the hay is a fair article of its kind. It served during the gluten-meal feeding experiment with milch cows.

FIELD EXPERIMENTS.

The Experiment Station has entered already, in its first year of existence, upon a systematic course of experiments to assist in determining the influence, mode of cultivation, of system of manuring, and of stage of growth, on the comparative feeding value of some of our prominent farm crops.

The results thus far published, although essentially of local interest, deserve more than a passing notice, on account of the scarcity of examinations of a similar character of forage crops raised under quite common circumstances within the limits of the State.

The significance of the various analytical results will become more apparent as the work progresses.

As the character of our soil, and its particular state of fertility, ought to be better known before a more detailed discussion of the connection between soil, season and composition of the crop can be considered profitable, a mere record of the progress of the analytical work is all that can be consistently published at the present stage of the investigation.

Aside from the trials with some of our standard forage crops, there have been also inaugurated experiments with the cultivation of reputed forage crops of other localities and countries, to test their adaptability to our soil and climate. The successful introduction of a greater variety of valuable fodder crops, promises to furnish a wider range of fodder-substances, as far as their relative, as well as absolute, nutritive value is concerned, a circumstance not less acceptable to our agricultural industry than it has proved elsewhere. The best interests of the dairy business call for an efficient protection against a serious periodical influence of drought on the yield of meadows and pastures. The cultivation of fodder crops, growing upon different kinds of soil, and maturing at different periods of the season, have proved of valuable assistance in that direction. Some of the results of our trials with cow pea, serradella, vetch, common lucerne (alfava), sand lucerne, horse bean, lupine and pearl millet, will be reported within a few subsequent pages. This record of our past work in this direction makes no other claim than to more prominently introduce the subject.

1. Fodder Corn (without Manure), upon Underdrained Plats.

[See Sketch A, p. 408.]

In the first annual report of the station has been described by Prof. M. Miles, the underdraining of a piece of land, one and one-tenth of an acre in size, subdivided into eleven plats.

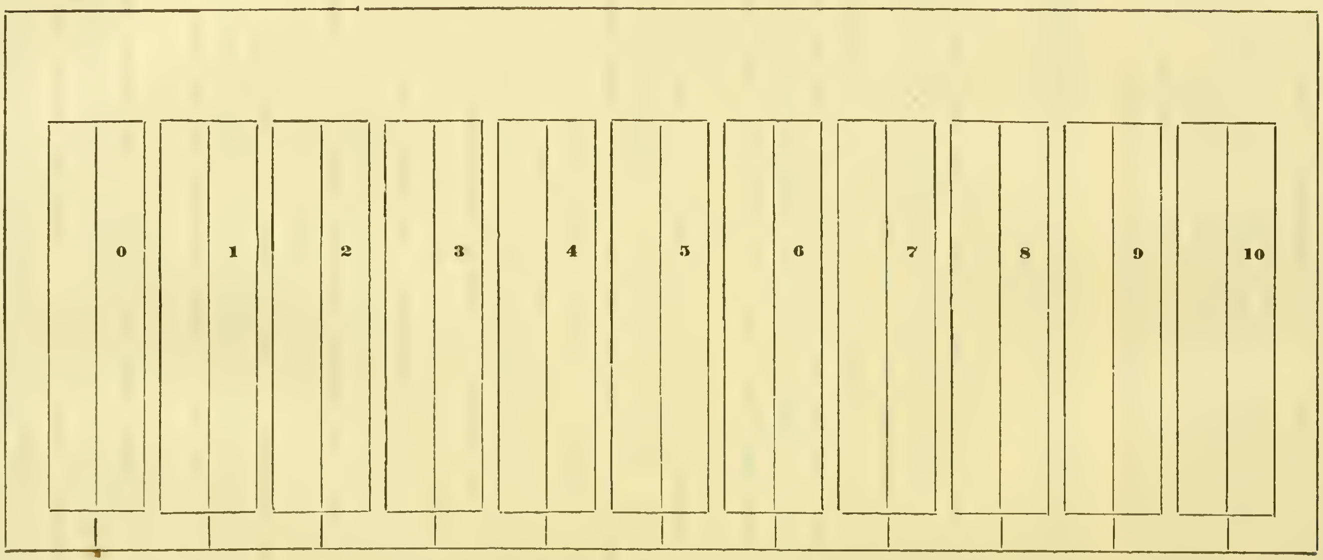
The field was designed to serve for an examination into the action of various manurial substances on the growth of corn, and the influence on the character of the drainage water discharged from the drains, under a different treatment of the soil.

The chemical analysis of the first water running from the pipes of the different plats after a rainfall May 22, 1883, has been reported in the above-mentioned connection; and also the character of the soil, cultivation of the cornfield, and the final yield of corn and of stalks.

No manure was applied that year. It was desirable, in the interest of the particular experiments hereafter to be carried on upon that field, that its latent resources of plant-food should be, as far as practicable, exhausted, with reference to the requirements for the production of Indian Corn.

During the past season the field has been planted again with corn, for corn fodder, without the application of manure of any description. The soil received a thorough mechanical preparation by ploughing and harrowing, and the corn (variety : Clark) was planted in drills, two and one-half feet apart, at the rate of two bushels per acre, on the 24th of May. The entire area was ploughed lengthwise, and thus across the plats. The crop was kept clean from weeds by timely use of the cultivator. The plants started well in the spring, yet began soon to fall behind, in general appearance, other fodder cornfields in the vicinity, upon fertilized lands.

SKETCH "A."


0
1
2
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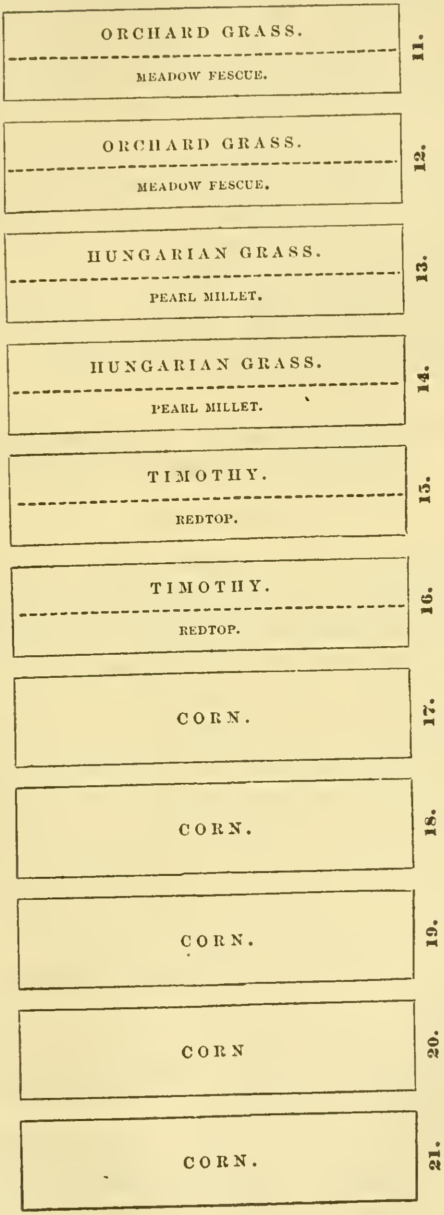
9
10

Corn Plats with Drainage System. Scale, 4 rods to 1 inch.

SKETCH "B."


ORCHARD GRASS.
MEADOW FESCUE.
11.
ORCHARD GRASS.
MEADOW FESCUE.
12.
HUNGARIAN GRASS.
PEARL MILLET.
13.
HUNGARIAN GRASS.
PEARL MILLET.
14.
TIMOTHY.
REDTOP.
15.
TIMOTHY.
REDTOP.
16.
CORN.
17.
CORN.
18.
CORN.
19.
CORN
20.
CORN.
21.

Corn and Grass Plats. Scale, 4 rods to 1 inch.

At the beginning of blooming it turned gradually yellow, failed to produce grain-bearing cobs, and suffered, toward the end of the month of August, seriously, from smut.

The corn was cut on the first of September and stacked in the field for drying. The entire yield of corn fodder from this piece of land, one and one-tenth of an acre in size, amounted to 5,040 pounds, with a moisture of thirty per cent.

The soil is evidently in suitable condition for studying the special effects of various forms and kinds of plant food on the corn during the coming season.

It is worthy to notice the fact, that vigorous corn crops, growing upon fertilized fields, alongside, upon a similar soil, showed no smut at the same period of growth.

2. INFLUENCE OF FERTILIZERS ON THE QUANTITY AND QUALITY OF FODDER CROPS.

[See Sketch B, p. 409.]

The land selected for the experiment had been used, for several years previous, for the production of hay. At the beginning of the season of 1883, it had been ploughed and planted with corn, without the addition of any fertilizer. The soil consisted of a good sandy loam, and was, in consequence of its previous treatment, in a suitably impoverished condition to respond to the application of fertilizers.

The entire field, consisting of one and one-tenth of an acre, was sub-divided into plats, each one-tenth of an acre in size. Every alternate plat was fertilized at the rate of six hundred pounds of ground, rendered bones, and two hundred pounds of muriate of potash, per acre. The fertilizer was applied a few days before seeding, and slightly harrowed under.

The fertilized plats (Nos. 11, 13, 15, 17, 19 and 21) were seeded May 13; and the unfertilized plats (Nos. 12, 14, 16, 18 and 20) May 17, 1884.

The experiment comprised four standard grasses, *i. e.*, Orchard grass *(Dactylis glomerata)*, Meadow fescue (*Frestuca pratensis*), Timothy *(Phleum pratensis)*, and Redtop *(Agrostis vulgaris)*, besides two millets, — Hungarian grass *(Panicum Germanicum)* and Pearl millet, — and one variety of corn (Clark). In the case of the grasses and millets, each plat was again sub-divided in two, and each one-half seeded down with one distinct kind of grass seed as follows: —

Plat I. (fertilized), . . .	Orchard Grass (north side). Meadow Fescue (south side).
Plat II. (unfertilized), . .	Orchard Grass (north side). Meadow Fescue (south side).
Plat III. (fertilized), . .	Hungarian Grass (north side). Pearl Millet (south side).
Plat IV. (unfertilized), . .	Hungarian Grass (north side). Pearl Millet (south side).
Plat V. (fertilized), . . .	Timothy (north side). Redtop (south side).
Plat VI. (unfertilized), . .	Timothy (north side). Redtop (south side).
Plat VII. (fertilized), . . .	Corn (Clark).
Plat VIII. (unfertilized), . .	Corn (Clark).
Plat IX. (fertilized), . . .	Corn (Clark).
Plat X. (unfertilized), . .	Corn (Clark).

The corn was planted the 24th of May, in drills two and one-half feet apart, at the rate of two bushels per acre. A severe frost on the night of from 29th to 30th of May, injured the millets seriously, and the remaining crops slightly.

The corn was kept clean by the use of a cultivator. The grasses were repeatedly cut, for the mere purpose of killing the weeds off. Their examination, regarding quality, as well as quantity, is, for obvious reason, deferred to the second year of their growth.

Results of Experiments with Corn.

Fertilized Plats, $\frac{1}{10}$ of an acre each.	Plat VII. Plat IX.	4,340 lbs. 3,096 lbs.	Total yield, 7,436 lbs.
Unfertilized Plats, $\frac{1}{10}$ of an acre each.	Plat VIII. Plat X.	2,460 lbs. 2,556 lbs.	Total yield, 5,016 lbs.

Yield of Fertilized Plats, per acre, ...	37,180 lbs.
Yield of Unfertilized Plats, per acre, ...	25,080 lbs.
Difference in yield, ...	12,100 lbs.

The entire crop of corn fodder was cut September 1. The corn fodders growing upon the fertilized and unfertilized plats, differed widely from each other, in their general appearance during the second half of the season. The growth upon the former retained its healthy and vigorous appearance to the time of cutting, whilst that raised upon the unfertilized plats turned gradually yellow, and suffered, at the close of the season, seriously, from smut.

The crop gathered from the fertilized plats was converted into ensilage; and that from the unfertilized plats was stacked in the field for dry corn fodder.

Analysis of Green Fodder Corn.

		Plat VII. (Fertilized.)	Plat VIII. (Unfertilized.)
1884.			
July 25, at the beginning of Blooming.	Moisture at 100° C.,	87.62	85.15
	Dry Vegetable Matter,	12.38	14.85
Sept. 1, Kernels in Milk.	Moisture at 100° C.,	72.27	78.77
	Dry Vegetable Matter,	27.73	21.23

Judging from these results it appears that the plants upon the unfertilized plats advanced more rapidly towards maturity than those upon the fertilized fields, yet fell considerably behind in the production of vegetable matter at the close of the season; for one hundred parts of the former contained only 21.23 per cent. dry matter, while the latter showed a yield of 27.73 per cent. of dry matter, a difference of 6.5 per cent. One hundred pounds of the fodder corn, grown upon the unfertilized plats, contained at the time of harvesting (kernels in milk), 6.5 pounds less of vegetable matter than the one raised upon the fertilized plats, a difference equal to from twenty to twenty-five per cent. of vegetable matter in favor of the fertilized fodder corn. Adding to this advantage the difference in the total weight of corn fodder at the time of harvesting, an amount equal to thirty-three per cent. of the entire growth, it is but proper to state that the total effect of the fertilizer on the crop should be rated in our case with an increase equal to from forty-eight to fifty per cent. of the entire crop.

Composition of Dry Vegetable Matter in Corn Fodder (fertilized).

One hundred parts contained:—

Crude ash,	3.16 parts.
" cellulose,	24.32 "
" fat,	2.89 "
" protein,	9.64 "
Non-nitrogenous extract matter,	59.99 "

3. EXPERIMENTS WITH POTATOES.

Var.: BEAUTY OF HEBRON.

These experiments were instituted for the purpose of studying the effects of muriate of potash and of sulphate of potash on the yield of potatoes as far as quantity and quality are concerned. The conclusions drawn in this direction from previous investigations are somewhat contradictory. Some practical observers state that the sulphate of potash produces a more mealy tuber, and thus a more valuable article for family use, than the muriate of potash, while others deny that claim.

A mealy potato contains usually a liberal percentage of starch and a low one of nitrogenous matter. As the degree of maturity of a plant or part of a plant controls, to a large extent, the relative proportions of its proximate organic constituents, as starch, nitrogenous matter, etc., it seems not without interest to ascertain whether the noted difference of opinion regarding the specific action of sulphate and muriate of potash might not find a more correct explanation in the assumption that a more or less advanced state of maturity of the various crops of potatoes tested on previous occasions may account for the contradictory conclusions on record.

Three plats, each one-fifth of an acre in size, were chosen for the experiment. The land had been years in grass and contained quite a number of old apple trees. The majority of the latter were removed, and the turf thoroughly broken up before manuring.

Plat one (west end) received one hundred and twenty pounds of ground rendered bones and thirty pounds of muriate of potash (equal to from twenty-six to twenty-seven pounds of phosphoric acid, four to four and one-half pounds of nitrogen, and fifteen to sixteen pounds of potassium oxide).

Plat two received no manure of any kind.

Plat three (east end) received one hundred and twenty pounds of ground rendered bones, fifty-eight pounds of double sulphate of potash and magnesia (equal to from twenty-six to twenty-seven pounds of phosphoric acid, four to four and one-half pounds of nitrogen, fifteen to sixteen pounds of potassium oxide, and five to six pounds of magnesium oxide).

The fertilizers were applied broadcast and harrowed under before planting. The potatoes were planted in rows, three feet apart and fourteen inches distant in the drills, during the first week in May, 1884. The crop was kept clean from weeds by a timely use of a cultivator.

As a mere incidental feature of the experiment, one-half of each plat was planted with medium-sized whole potatoes, the other one with half potatoes.

The vines produced by whole potatoes showed a more vigorous growth, during the main part of the season, than those by part of a potato. The entire field looked promising until towards the middle of August, when the appearance of the blight prematurely terminated the life of the stems and leaves.

The crop was harvested on the 9th and 10th of September, with the following results: —

PLAT I.

SEED POTATOES.	Fertilizer applied.	Yield of Potatoes upon One-Fifth of an Acre of Land, in Pounds.		
		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. ground rendered bones and 30 lbs. muriate of potash.	1,085	460	1,545
One-half a Potato,		1,140	335	1,485

PLAT II.

		Large.	*Small.*	*Total.*
Whole Potato, .	Not Fertilized.	830	280	1,110
One-half a Potato,		850	250	1,100

PLAT III.

		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. ground rendered bones and 58 lbs. of double sulphate of potash and magnesia.	1,120	342	1,462
One-half a Potato,		930	105	1,035

Analyses of Potatoes.

One hundred weight parts of air-dried fresh potatoes contained:

	From Plat I.	From Plat II.	From Plat III.
Dry Vegetable Matter, . . .	19.39	23.30	21.52
Water, ...	80.61	76.70	78.48
	100.00	100.00	100.00

A well matured potato contains on an average, approximately, twenty-five per cent. of solid matter. The unmanured potatoes were evidently more advanced in growth, whilst those manured with muriate of potash were least advanced in that direction.

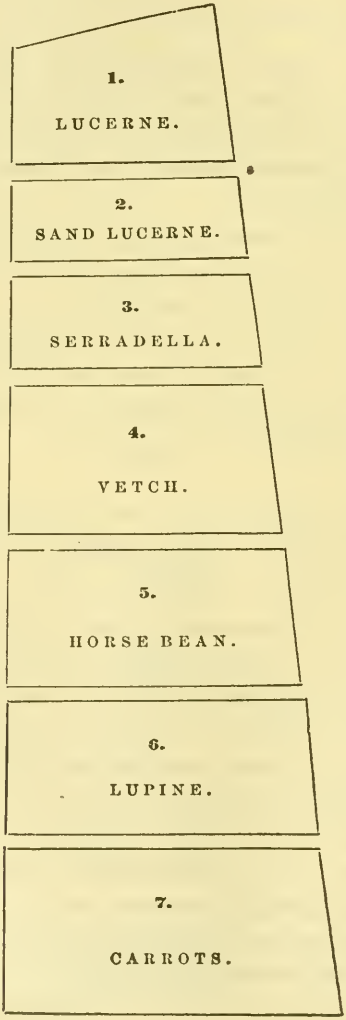
The latter, on the other hand, had the smoothest skins, and were almost entirely free from scab, which disfigured seriously those from Plats II. and III.

As a first trial, under unfavorable circumstances, does not entitle to a critical discussion of results beyond a mere statement of the facts as above recorded, it is proposed to repeat the experiment during the coming season.

4. EXPERIMENTS CONCERNING THE ADAPTATION OF SOME REPUTED FORAGE CROPS, FROM OTHER LOCALITIES, TO OUR CLIMATE AND SOIL.

The desirability of introducing into our farm management a greater variety of fodder plants, is generally conceded. In choosing plants for that purpose, it seemed advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pasture and meadows), the fodder corn and corn stover, as green fodder as well as in the form of hay. Taking this view of the question, the great and valuable family of *Leguminosæ* suggested itself, as a class of plants in a particular degree qualified for that purpose, not only, but, in the interest of a wider range, for the introduction of economical systems of rotation under various conditions of soil and different requirements of markets.

The results thus far obtained upon the fields of the station, although still limited, are not without considerable encouragement. A short description of the work carried on in that direction is given in a few subsequent pages. The experiment with cow peas was carried on during the season of 1883; those with vetch and serradella extended over two seasons, 1883 and 1884; and those with lucerne and horse bean began with the season of 1884.


1.
LUCERNE.
2.
SAND LUCERNE.
3.
SERRADELLA.
4.
VETCH.
5.
HORSE BEAN.
6.
LUPINE.
7.
CARROTS.

SKETCH "C."

Forage Plats (1884.) Scale, 80 feet to 1 inch.

Our first year's observations are mainly directed towards their behavior with regard to our climate and soil. The economical questions involved in their cultivation will receive, whenever desirable, during coming years, special attention.

None of the crops treated under the above heading suffered to any serious extent from the severe frost on the 29th of May.

The results of the experiments with lupine and two varieties of lucerne are not stated in this report, as the examination of the products obtained is not yet finished.

The results in the field were quite encouraging.

[A.] COW PEA.

DOLICHOS (SINENSIS?); VARIETY, CLAY.

[From Experimental Plats of Station; collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.30	186.00	–	–	1 : 4.75
Dry Matter, ...	90.70	–	–	–	
Analysis of Dry Matter.	100.00		–	–	
Crude Ash, ...	9.53	190.60	–	–	
" Cellulose, . . .	23.58	471.60	221.65	47	
" Fat, ...	3.81	76.20	44.96	59	
" Protein, . . .	17.02	340.40	204.24	60	
Non-nitrogenous Extract Matter, ...	46.06	921.20	635.63	69	
	100.00	2,000.00	1,106.48	–	

The seeds for these experiments were obtained through the kindness of Dr. Dabney, director of the State Experiment Station of North Carolina. The rates of digestibility of the various constituents of the hay of the cow pea, above stated, are those of clover hay, a fodder substance of a similar character. The "Clay" variety of the cow pea is considered the best of the many varieties raised in the Southern States. The merits of this plant are described by a farmer of North Carolina in the following words: —

> "It has no tendrils but twines like beans, or runs upon its own foliage. It is of a rapid growth, making, in three months, on ordinary land, an

almost impenetrable mass of foliage, two feet high, and so very dense that it destroys all other vegetation, even the thistle, ragweed, and other noxious plants. When well cured these vines are simply invaluable for hay, and worth, as ascertained by actual experiments, 33 to 50 per cent. more than timothy. The only difficulty in making them the leading crop for hay is that it takes three days to cure them. Cattle and horses prefer such hay to the best of herds-grass, and even to corn. Pea vines are the best fertilizer we can use, decomposing very rapidly. I have frequently cut off the vines before they began to run (July 1), and by August the roots would throw out new vines two feet long. The seed sold in May for 75 cents per bushel."

The experimental plats were seeded down towards the latter part of May, and produced a handsome, dense foliaceous growth, about eighteen inches high, at the beginning of August when the samples for analysis were collected.

The early frost in September injured the crop. The plant apparently deserves the importance claimed for it in the above stated report. Its cultivation has proved a success in New Jersey. The only objection which might be raised against its introduction consists in the circumstance that matured seeds cannot be relied on in our section of the country.

As a green fodder it compares well with clover, and most likely would produce a valuable ensilage.

COW PEA.

VARIETY: WHIPPOORWILL.

[From Experimental Plats of Station; collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . . .	9.65	193.00	–	–	1:4.74
Dry Matter, ...	90.35	1,807.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	10.46	209.20	–	–	
" Cellulose, ...	22.36	447.20	210.18	47	
" Fat, ...	3.87	77.40	45.67	59	
" Protein (Nitrogenous Matter, ...	16.95	339.00	203.40	60	
Non-nitrogenous Extract Matter, ...	46.36	927.20	639.77	69	
	100.00	2,000.00	1,099.02	–	

The variety of the preceding table is described as making but little vine, and is considered less valuable than the "Clay" variety. It made a dense foliaceous growth, fully equal to the latter in size. Neither of them produced seeds.

COW PEA.

VARIETY: WHIPPOORWILL.

[Raised on Plats of Station, as Mixed Crop, with Oats. Collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.75	195.00	–	–	1 : 4.95
Dry Matter,	90.25	1,805.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.87	157.40	–	–	
" Cellulose,	19.06	381.20	179.16	47	
" Fat,	4.49	89.80	52.98	59	
" Protein (Nitrogenous Matter),	17.17	343.40	206.04	60	
Non-nitrogenous Extract Matter,	51.41	1,028.20	709.46	69	
	100.00	2,000.00	1,147.64	–	

The analysis was made from the pea vines raised with the oats; the analysis of the latter has been reported in Bulletin 5 (No. 102). This course of separate analysis was adopted on account of the uneven distribution of both plants. The mixed crop was, on the first of August, in excellent condition for green fodder or hay. An experiment with rye failed, on account of a bad quality of rye. Assuming the mixed crop of peas and oats to consist of three times as much oats as peas, the nutritive ratio of the mixture would be 1 : 12. In case of two parts of oats and one of cow peas, the ratio would 1 : 10, and in case of even quantities of both plants, the ratio would be 1 : 8.7. Raised in connection with rye the nutritive value of the mixed crop would be still higher. Within three months' time, a fodder can be raised *fully equal, if not decidedly superior in nutritive value, to our best English grasses.*

[B.] VETCH.

(*Vicia sativa; variety, Augustifolia.*)

The vetch has received already considerable attention in various sections of our country; reports thus far speak with much satisfaction of the results. The plant resembles, in many respects, the common garden pea; there are early and late varieties in cultivation. Its period of vegetation is from 18 to 22 weeks, and the time for seeding corresponds with that of the pea. The common vetch is a hardier plant than the latter, and grows well upon an inferior soil. Its reputation as a valuable green fodder, either single or when grown in common with rye, oats or barley, is well established.

The lands were seeded down broadcast, in our experiment during the past season, on the 15th of May. The first crop was secured July 2, at the beginning of blooming. One hundred parts of the plant in that state of growth contained: —

Moisture at 100° C., ...	78.20 per cent.
Dry Matter (vegetable), ...	21.80 " "
	100.00

VETCH.

(VICIA SATIVA; VARIETY, AUGUSTIFOLIA.)

[I. Collected from Experimental Plats, Aug. 15, 1883, in bloom.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.35	167.00	–	–	1 : 4.02
Dry Matter, ...	91.65	1,833.00	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	7.97	159.40	–	–	
" Cellulose, . . .	30.68	613.60	331.34	54	
" Fat, ...	2.30	46 00	27.60	60	
" Protein (Nitrogenous Matter), . . .	15.76	315.20	239.55	76	
Non-nitrogenous Extract Matter, ...	43.29	865.80	562.77	65	
	100.00	2,000.00	1,161 26	–	

VETCH.

[II. Collected from Experimental Plats, Sept. 3, 1883, when fully matured.]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.45	189.00	–	–	1 : 4.09
Dry Matter,	90.55	1,811.00	–	–	
Analysis of Dry Matter.	100.00	2,000.00	–	–	
Crude Ash,	8.50	170.00	–	–	
" Cellulose,	30.05	601.00	270.45	45	
" Fat,	2.69	53.80	32.28	60	
" Protein (Nitrogenous Matter),	14.42	288.40	204.76	71	
Non-nitrogenous Extract Matter,	44.34	886.80	487.74	55	
	100.00	2,000.00	995.23	–	

[C.] SERRADELLA.

(*Ornithopus sativus. Brot.*)

The serradella, like the vetch, is an annual leguminous plant, which found its way from Portugal into central Europe some fifty years ago. It grows from one foot to one foot and one-half high, and prefers a moist, deep, sandy soil. Time of seeding and mode of cultivation correspond with those customary in the cultivation of peas. The growth of the plant is slow until the time of blooming, when it rapidly increases in size and nutritive constituents. The close of the blooming period, at the end of August, is the best time for cutting the crop. Leading agriculturists speak very highly of this fodder plant. The field seeded down broadcast on the 15th of May, 1884, produced a first crop, blooming on the 22d of July. The plants, at that period of their growth, contained in one hundred parts: —

Moisture at 100° C.,	78.66 parts
Vegetable Matter (dried),	21.34 "
	100.00

SERRADELLA.

(ORNITHOPUS SATIVUS. BROT.)

[I. Obtained from Plats of the Station, when blooming, Aug. 14, 1883.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	7 20	144.00	–	–	1 : 4.72
Dry Matter, ...	92.80	1,856.00	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	5.87	117.40	–	–	
“ Cellulose, . . .	24.37	487.40	–	–	
“ Fat, ...	2.37	47.40	28.44	60	
“ Protein (Nitrogenous Matter), . . .	17.85	357.00	224.91	63	
Non-nitrogenous Extract Matter, ...	49.54	990.80	990.80	100	
	100.00	2,000.00	1,244.15	–	

SERRADELLA.

[II. From Plats of Station, collected Sept. 3, 1883, when fully matured]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.70	174.00	–	–	1 : 5.47
Dry Matter, ...	91 30	1,826.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	6.46	129.20	–	–	
“ Cellulose, . . .	25 14	502.80	236 32	47	
“ Fat, ...	2.91	58.20	29.10	50	
“ Protein (Nitrogenous Matter), . . .	15.26	305.20	183.12	60	
Non-nitrogenous Extract Matter, ...	50.23	1,004.60	693.17	69	
	100.00	2,000.00	1,141.71	–	

The two foregoing stated analyses of Serradella in different stages of growth (1883), confirm the general observation that the leguminous plants, like the clover, vetch, beans, peas, etc., as a rule, furnish the most nutritious food at the time of blooming.

[D.] Horse Bean.

(*Vicia Faba. L.*)

The plant came from Southern Russia, and was cultivated at an early date, already, in Southern Europe. There are several varieties, small and large, in use. The latter is at present quite frequently raised in the gardens of England, France and Germany, for family use; whilst the smaller variety, like the one on trial, is cultivated throughout Europe for fodder.

The ground beans are considered a valuable food for horses, milch cows and swine. The softer parts of the straw form a valuable addition to the daily diet of the majority of the farm stock. Beans and straw are highly nitrogenous. The horse bean is considered one of the most reliable leguminous plants upon a heavy loam or dry clayish soil, in a temperate and moderately moist climate. Raised with vetch and peas, it serves a twofold purpose, *i. e.*, to uphold the vines of these plants, and to increase their feeding value as green fodder. They are planted quite early, in rows from two to two and one-half feet distant, and two inches apart in the drills. The plant reaches a height of from two to three feet at the beginning of blooming, and has a thick, hollow, somewhat angular, juicy stem, with succulent leaves, which at the time of maturing turn black.

The field upon the grounds of the station was seeded down the 15th of May, 1884, in rows two and one-half feet apart. It was kept clear from weeds by means of a cultivator. The crop was very satisfactory. It began blooming in the first week of July. The plants at that time contained in one hundred parts: —

Moisture at 100° C., ...	87.72	parts.
Vegetable Matter (dried), ...	12.28	"
	100.00	

At the time of harvesting, when the pods were fully developed, one hundred parts of the entire plant contained: —

Moisture at 100° C.,	73.14	parts.
Vegetable Matter,	26.86	"
	100.00	

The crop was cut several inches above ground, put into small shocks, and kept upon the field until September 15, when it was dry enough for storing in the barn. The total crop at that time weighed 405 lbs.; it lost 4.5 per cent. more moisture from that date to the 17th of October, when, by thrashing, the beans were separated from the straw.

HORSE BEAN.

(Vicea Faba.)

[Collected from the plats of the Station when harvested.]

Moisture at 100° C.,	73.14	parts.
Dry Vegetable Matter,	26.86	"

	Straw.	Bean.
Moisture at 100 C.,	9.15	10.28
Dry Matter,	90.85	89.72

Analysis of Dry Matter.

Crude Ash,	9.59 per cent.	4.27 per cent.
" Cellulose,	41.44 "	8.11 "
" Fat,	1.51 "	1.11 "
" Protein (Nitrogenous Matter),	9.69 "	30.03 "
Non-nitrogenous Extract Matter,	37.77 "	56.48 "
Ratio of Beans to Straw,		46 : 54

OBSERVATIONS REGARDING THE RATES OF DIGESTIBILITY OF BOTH BEANS AND STRAW WITH EMPTY PODS.

I. HORSE BEAN.

RESULTS OBTAINED BY FEEDING IT TO CATTLE.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.28	205.60	–	–	1 : 224.
Dry Matter, ...	89 72	1,794.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	4.27	85.40	–	–	
" Cellulose, . . .	8 11	162.20	102.19	63	
" Fat, ...	1.11	22.20	21.53	97	
" Protein (Nitrogenous Matter), . . .	30.03	600.60	540.54	90	
Non-nitrogenous Extract Matter, ...	56.48	1,129.60	1,061.82	94	
	100.00	2,000.00	1,726.08	–	

II. BEAN STRAW AND PODS.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Analysis of Dry Matter.					
Crude Ash, ...	9.59	191.80	–	–	1 : 8.55
" Cellulose, . . .	41.44	828.80	298.37	36	
" Fat, ...	1.51	30.20	16.61	55	
" Protein (Nitrogenous Matter), . . .	9.69	193.80	98.84	51	
Non-nitrogenous Extract Matter, ...	37.77	755.40	460.79	61	
	100.00	2,000.00	874.61	–	

EXPERIMENTS WITH CORN ENSILAGE.

The silo described by Prof. M. Miles in the first annual report of the station has been sub-divided into two independent compartments of equal size, each one accessible by a separate entrance. This change has been made to meet present resources of corn fodder for ensilage, and to carry on two independent trials if desirable.

One of these silos was filled with cut corn fodder as in the previous experiments. The filling of this silo was carried on as recommended by Prof. Miles and others, *i. e.*, to fill gradually and to defer the final covering and packing down to the time when no further increase of temperature in the mass can be noticed. This course purposes to restrict and, if possible, prevent the alcoholic fermentation and subsequent formation of acetic acid in consequence of the destruction of the bacteria of fermentation by heat.

The second silo was filled with whole corn fodder, carefully spread out and at once well tramped down. After filling, the cover was put on and weighted down without delay.

The corn was in both cases kept down by an equal weight, similar to that in the trial of the previous year, — barrels filled with sand, giving a pressure of about sixty pounds to the square foot.

The corn fodder used for the filling of both silos was taken from the fertilized plats, which are described in this report in connection with the experiments concerning the effect of fertilizer on the quantity and quality of crops. The growth of each plat was divided into two parts; one-half was cut into pieces 1¼ to 1½ inches in length, and subsequently filled into one silo, the other half was packed into the second one without being cut, as above described.

This arrangement secured, as far as practicable, for both trials, a material of a corresponding general character and composition. The entire stock of good fodder corn at our disposal amounted to 15,272 pounds, or seven and six-tenths tons. The corn was cut when the kernels were in the milk, to secure a more nutritious ensilage than at an earlier period of growth could be expected.

There is a considerable difference in the value of a fodder corn just sending out tassels and one with kernels in the milk, like the one used in our case.

A fodder corn in the former stage of growth contains in many instances only from twelve to fifteen weight parts of dry vegetable matter in one hundred of the entire plant, whilst in the more advanced stage of growth, when the kernels are in the milk and the whole plant still green, the dry vegetable matter contained in one hundred weight parts of the entire plant varies usually between from twenty-five to twenty-eight parts; therefore, a difference of thirty-three per cent. in actual fodder, pound for pound, in favor of the latter stage of growth.

Aside from this decided advantage in actual weight, it is not less certain that the quality of the fodder obtained from the more matured fodder corn is of a superior nutritious character when compared with that of the less matured article. For the nitrogenous constituents of the more matured fodder corn, although less in quantity, are more largely of a kind (true albuminoids) better fitted for the formation of blood than they are at an earlier stage of growth. The entire plant is also richer in valuable non-nitrogenous constituents, as fat, sugar and starch, than in the latter case.

To ascertain the degree of temperature within the ensilage at the various stages of its alteration, a gas-pipe one and one-fourth inch in diameter was driven, in each case, through a tight-fitting hole in the cover of the silo to within one foot of its floors. A thermometer was kept inside of this tube to note from time to time the changes in the temperature of the ensilage. The results of these observations are stated below.

The expense for filling the silo amounted to $1.50 per ton of corn-fodder ensilage.

As the silos are not yet opened a further discussion of the silo-product has to be deferred to an early bulletin of the station.

Observations on Whole Fodder Corn in Silo.

Commenced filling the silo at 7 o'clock, A.M., September 1, and finished at 2 o'clock, P.M., the same day. The mass, with weights on, measured at once 5 ft. $4\frac{1}{4}$ in. in depth; first temperature observed in the tube at 3 o'clock, P.M., September 1, was 77° F. (25° C.); outside temperature, 71.6° to 73.4° F. (22° to 23° C.).

DATE.	Time of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkage.
Sept. 1,	5 o'clock, P.M.	77.° F.	–	5 ft. $2\frac{3}{4}$ in.	$1\frac{1}{2}$ inches.
2,	8.30 o'clock, A.M.	78.8°	–	5 “ $1\frac{1}{4}$ “	$2\frac{7}{8}$ “
3,	“ “ “	81.5°	–	4 “ $10\frac{3}{8}$ “	3 “
4,	“ “ “	85.1°	–	4 “ $7\frac{3}{8}$ “	$3\frac{1}{8}$ “
5,	“ “ “	89.6°	–	4 “ $4\frac{1}{4}$ “	$2\frac{5}{8}$ “
6,	“ “ “	89.6°	–	4 “ $1\frac{5}{8}$ “	$2\frac{4}{8}$ “
7,	“ “ “	88.7°	–	3 “ $11\frac{1}{8}$ “	$1\frac{5}{8}$ “
8,	“ “ “	93.2°	–	3 “ $9\frac{1}{2}$ “	$1\frac{5}{8}$ “
9,	“ “ “	93.2°	–	3 “. $7\frac{7}{8}$ “	1 “
10,	“ “ “	94.1°	–	3 “ $6\frac{7}{8}$ “	$1\frac{4}{8}$ “
11,	“ “ “	94.1°	86.° F.	3 “ $5\frac{3}{8}$ “	$\frac{4}{8}$ “
12,	“ “ “	86.°	68.°	3 “ $4\frac{7}{8}$ “	$\frac{5}{8}$ “
13,	“ “ “	82.4°	57.2°	3 “ $4\frac{2}{8}$ “	$\frac{5}{8}$ “
14,	6 o'clock, P.M.	84.2°	64.4°	3 “ $3\frac{5}{8}$ “	$\frac{2}{8}$ “
15,	8.30 o'clock, A.M.	82.4°	53.6°	3 “ $3\frac{3}{8}$ “	$\frac{2}{8}$ “
16,	8.30 o'clock, P.M.	82.4°	64.4°	3 “ $3\frac{1}{8}$ “	$\frac{8}{8}$ “
17,	“ “ “	82.4°	68.°	3 “ $2\frac{6}{8}$ “	$\frac{8}{8}$ “
18,	“ “ “	82.4°	62.6	3 “ $2\frac{3}{8}$ “	$\frac{1}{8}$ “
19,	“ “ “	80.6°	55.4°	3 “ $2\frac{2}{8}$ “	$\frac{2}{8}$ “
20,	“ “ “	80.6°	55.4°	3 “ 2 “	$\frac{1}{8}$ “

Observations on Whole Fodder Corn, etc. — Concluded.

DATE.	Time of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkage.
Sept. 21,	8.30 o'clock, P.M.	79.7°	55.4°	3 " $1\frac{7}{8}$ in.	$\frac{1}{8}$ inches.
22,	" " "	78.8°	57.2°	3 " $1\frac{6}{8}$ "	0 "
23,	" " "	77.°	60.8°	3 " $1\frac{6}{8}$ "	0 "
24,	" " "	75.2°	55.4°	3 " $1\frac{6}{8}$ "	$\frac{3}{8}$ "
25,	" " "	77.°	75.2°	3 " $1\frac{3}{8}$ "	0 "
26,	" " "	74.3°	57.2°	3 " $1\frac{3}{8}$ "	$\frac{2}{8}$ "
27,	" " "	75.2°	57.2°	3 " $1\frac{1}{8}$ "	0 "
28,	" " "	74.3°	71 6°	3 " $1\frac{1}{8}$ "	0 "
29,	" " "	75.2°	71.6°	3 " $1\frac{1}{8}$ "	0 "
30,	" " "	75.2°	62.6°	3 " $1\frac{1}{8}$ "	0 "
Oct 1,	" " "	73.4°	–	3 " $\frac{7}{8}$ "	$\frac{2}{8}$ "
2,	" " "	73.4°	–	3 " $\frac{7}{8}$ "	0 "
3,	" " "	71.6°	–	3 " $\frac{6}{8}$ "	$\frac{1}{8}$ "
4,	" " "	71.6°	–	3 " $\frac{6}{8}$ "	0 "
5,	" " "	71.6°	–	3 " $\frac{6}{8}$ "	0 "
6,	" " "	69.8°	–	3 " $\frac{6}{8}$ "	0 "
7,	" " "	69.8°	–	3 " $\frac{6}{8}$ "	0 "
8,	" " "	68.°	–	3 " $\frac{6}{8}$ "	0 "
9,	" " "	–	–	– –	– –
10,	" " "	–	–	– –	– –
11,	" " "	–	–	– –	– –
18,	" " "	68.°	59.°	3 " $\frac{4}{8}$ "	$\frac{2}{8}$ "
25,	" " "	62.6°	46.4°	3 " $\frac{4}{8}$ "	0 "
Nov. 1,	" " "	62.6°	–	3 " $\frac{4}{8}$ "	0 "
8,	" " "	59.°	–	3 " $\frac{4}{8}$ "	0 "

Observations with Cut Fodder Corn in Silo.

Commenced filling the silo at 3 o'clock, P. M., September 1st, and finished at 12 o'clock, M., September 2d. Whole thickness of ensilage after levelling, taken at once, was 4 ft. $10\frac{7}{8}$ in.; temperature in the mass at 1 o'clock, P. M., September 2d, was 71.6° F. (22° C.). The weights were put on September 6th, when the temperature of the mass (122° F.) had ceased to increase.

DATE.	Time of Day.	Temperature in Tube.	Outside Temperature.	Thickness of Ensilage.	Shrinkage.
Sept. 1,	–	–	–	– –	– –
2,	–	–	–	4 ft. $10\frac{7}{8}$ in.,	– –
3,	6 o'clock, P.M.,	77.° F.,	–	– –	– –
4,	8.30 o'clock, A.M.,	78.8°	–	– –	– –
5,	" " "	82.4°	–	4 ft. $7\frac{1}{8}$ in.,	$3\frac{6}{8}$ inches.
6,	" " "	84.2°	–	4 " $6\frac{6}{8}$ "	$\frac{3}{8}$ "
7,	" " "	86.9°	–	3 " $11\frac{3}{8}$ "	$7\frac{3}{8}$ "
8,	" " "	86.9°	–	3 " $10\frac{5}{8}$ "	$\frac{6}{8}$ "
9,	" " "	86.9°	–	3 " 10 "	$\frac{5}{8}$ "
10,	" " "	87.8°	–	3 " $9\frac{5}{8}$ "	$\frac{3}{8}$ "
11,	" " "	88.7°	86.° F.,	3 " $9\frac{4}{8}$ "	$\frac{1}{8}$ "
12,	" " "	87.8°	68.°	3 " $8\frac{7}{8}$ "	$\frac{5}{8}$ "
13,	" " "	83.3°	57.2°	3 " $8\frac{4}{8}$ "	$\frac{3}{8}$ "
14,	6 o'clock, P.M.,	84.2°	64.4°	3 " $8\frac{4}{8}$ "	0 "
15,	8.30 o'clock, A.M.,	84.2°	53.6°	3 " $8\frac{4}{8}$ "	0 "
16,	8 30 o'clock, P.M.,	82.4°	64.4°	3 " $8\frac{1}{8}$ "	$\frac{3}{8}$ "
17,	" " "	82.4°	68.°	3 " $8\frac{1}{8}$ "	0 "
18,	" " "	82.4°	62.6°	3 " $7\frac{7}{8}$ "	$\frac{2}{8}$ "
19,	" " "	80.6°	55.4°	3 " $7\frac{7}{8}$ "	0 "
20,	" " "	80.6°	55.4°	3 " $7\frac{7}{8}$ "	0 "

Observations with Cut Fodder Corn, etc. — Concluded.

DATE.	Time of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkage.
Sept. 21,	8.30 o'clock, P.M.	78.8°	55.4°	3 “ $7\frac{7}{8}$ in.	0 inches.
22,	“ “ “	78.8°	57.2°	3 “ $7\frac{7}{8}$ “	0 “
23,	“ “ “	77.°	60.8°	3 “ $7\frac{7}{8}$ “	0 “
24,	“ “ “	77.9°	55.4°	3 “ $7\frac{7}{8}$ “	0 “
25,	“ “ “	77.°	72.5°	3 “ $7\frac{7}{8}$ “	0 “
26,	“ “ “	76.1°	57.2°	3 “ $7\frac{6}{8}$ “	$\frac{1}{8}$ “
27,	“ “ “	75.2°	57.2°	3 “ $7\frac{6}{8}$ “	0 “
28,	“ “ “	75.2°	71.6°	3 “ $7\frac{6}{8}$ “	0 “
29,	“ “ “	75 2°	71.6°	3 “ $7\frac{6}{8}$ “	0 “
30,	“ “ “	73.4°	62.6°	3 “ $7\frac{6}{8}$ “	0 “
Oct. 1,	“ “ “	75.2°	–	3 “ $7\frac{6}{8}$ “	0 “
2,	“ “ “	73.4°	–	3 “ $7\frac{5}{8}$ “	$\frac{1}{8}$ “
3,	“ “ “	73.4°	–	3 “ $7\frac{5}{8}$ “	0 “
4,	“ “ “	73.4°	–	3 “ $7\frac{5}{8}$ “	0 “
5,	“ “ “	73.4°	–	3 “ $7\frac{5}{8}$ “	0 “
6,	“ “ “	73.4°	–	3 “ $7\frac{5}{8}$ “	0 “
7,	“ “ “	71.6°	–	3 “ $7\frac{5}{8}$ “	0 “
8,	“ “ “	–	–	– –	– –
11,	“ “ “	69.8°	–	3 “ $7\frac{3}{8}$ “	$\frac{2}{8}$ “
18,	“ “ “	68.°	–	3 “ $7\frac{3}{8}$ “	0 “
25,	“ “ “	64.4°	–	3 “ $7\frac{3}{8}$ “	0 “
Nov. 1,	“ “ “	62.6°	–	3 “ $7\frac{3}{8}$ “	0 “
8,	“ “ “	60.8°	–	3 “ $7\frac{3}{8}$ “	0 “

The highest temperature observed in the mass was noticed at 1.30, P. M., September 4th, and registered, at about 18 inches from surface, 116.6° F. (47° C.).

ANALYSES OF FODDER AND FODDER CROPS.

ANALYSES OF HAMPDEN PROLIFIC CORN.

[Samples sent on for examination.]

I. Raised by J. Lyman Shepard of Westfield, Mass., upon a sandy loam soil. The ear was nine and three-fourth inches long, of a whitish color, and contained eighteen rows of kernels. The weight of the ear was 473.4 grams, and that of the cob 111.30 grams. The cob was of a red color, and comprised 23.5 per cent. of the weight of the ear, the other 86.5 per cent. being kernels. The average weight of one kernel was .433 gram.

	Moisture.	Fat.	Nitrogenous Matter. (Protein.)	Non - nitrogenous Extract Matter.	Cellulose.	Ash.
Kernels, . . .	10.00	4.068	10.224	72 207	1.953	1.548

Nutritive ratio of kernels, 1 : 8.248.

II. Raised by Mrs. M. A. Clyde of Brightwood, Mass., upon a heavy soil. The ear was ten inches long, of a whitish color, and contained twenty rows of kernels. The weight of the ear was 491.4 grams, and that of the cob 107.4 grams. The cob was of a red color, and comprised 21.86 per cent. of the weight of the ear, the other 88.14 per cent. being kernels. The average weight of one kernel was 3.996 grams.

	Moisture.	Fat	Nitrogenous Matter. (Protein.)	Non - nitrogenous Extract Matter.	Cellulose.	Ash.
Kernels, ...	10.00	4.761	12.357	69.579	1.782	1.521

Nutritive ratio of kernels, 1 : 6.73.

CORN STOVER.

[From Plats of the Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.73	174 6	–	–	1 : 21.16
Dry Matter,	91.27	1,825.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	3.12	62.4	–	–	
" Cellulose,	34.28	685 6	–	–	
" Fat,	1.27	25.4	7.62	30	
" Protein (Nitrogenous Matter),	6.58	131.6	52.64	40	
Non-nitrogenous Extract Matter,	54.75	1,095.0	1,095.00	100	
	100.00	2,000.0	1,155.26	–	

WHEAT GRAIN.

[From Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.58	211.60	–	–	1 : 6.42
Dry Matter,	89.42	1,788.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude Ash,	2.18	43.60	–	–	
" Cellulose,	2.42	48.40	–	–	
" Fat,	1.79	35.80	30.64	80.0	
" Protein (Nitrogenous Matter),	13.35	267.00	240.30	90.0	
Non-nitrogenous Extract Matter,	80.26	1,605.20	1,484.81	92.5	
	100.00	2,000.00	1,755.75	–	

The composition of this article is a very fair one.

WHEAT STRAW.

[From the Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	6.50	130.00	–	–	1 : 29.09
Dry Matter, ...	93.50	1,870.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	7.44	148.80	–	–	
" Cellulose, . . .	40.74	814.80	423.70	52	
" Fat, ...	1.59	31.80	8.59	27	
" Protein, (Nitrogenous Matter), . . .	5.32	106.40	27.66	26	
Non-nitrogenous Extract Matter, ...	44.91	898.20	359.28	40	
	100.00	2,000.00	819.23	–	

The composition of this sample is better than the average article.

PEARL MILLET (IN BLOOM).

[Collected from Plats of Station, Sept. 19, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	6.20	124.00	–	–	1 : 8
Dry Matter, ...	93.80	1,876.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	4.80	96.00	–	–	
" Cellulose, . . .	35.91	718.00	–	–	
" Fat, ...	1.63	32.60	13.69	42	
" Protein, (Nitrogenous Matter), . . .	7.20	144.20	86.40	60	
Non-nitrogenous Extract Matter, ...	50.46	1,009.20	655.98	65	
	100.00	2,000.00	756.07	–	

COMMON MILLET.

[Collected from Plats of Station, when blooming, Aug. 14, 1883.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.15	123.00	–	–	1 : 8.32
Dry Matter,	93 85	1,877.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.67	93.40	–	–	
" Cellulose,	29.80	596.00	–	–	
" Fat,	2.04	40.80	17.14	42	
" Protein (Nitrogenous Matter),	7.69	153.80	92.28	60	
Non-nitrogenous Extract Matter,	55 80	1,116.00	725.40	65	
	100.00	2,000.00	834.82	–	

COMMON MILLET.

[From Plats of the Station, when fully matured, Sept. 3, 1883.]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.73	134.60	–	–	1 : 8.5
Dry Matter,	93.27	1,865.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.23	84.60	–	–	
" Cellulose,	33.39	667.80	–	–	
" Fat,	2.67	53.40	21.36	40	
" Protein (Nitrogenous Matter),	7.09	141.80	85.08	60	
Non-nitrogenous Extract Matter,	52.62	1,052.40	631.44	60	
	100.00	2,000.00	737.88	–	

The analyses of both samples point towards an exhausted condition of the soil on which they were raised.

HUNGARIAN GRASS (PANICUM GERMANICUM).

[From the Farm of Levi Adams, Hadley, Mass., collected in bloom, Sept. 4, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.45	149.00	–	–	1 : 6.22
Dry Matter,	92.55	1,851.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.73	114.60	–	–	
" Cellulose,	31.96	639.20	–	–	
" Fat,	2.22	44.40	18.65	42	
" Protein (Nitrogenous Matter),	9.45	189.00	113.40	60	
Non-nitrogenous Extract Matter,	50.64	1,012.80	658.32	65	
	100.00	2,000.00	790.37	–	

The composition of the above sample is very fair.

BARNYARD GRASS (PANICUM CRUS-GALLI.)

[Collected in bloom from College Farm, Aug. 14, 1883.]

	Percentage Competition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.65	133.00	–	–	1 : 2.94
Dry Matter,	93.35	1,867.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	10.82	216.40	–	–	
" Cellulose,	33.72	674.40	–	–	
" Fat,	1.95	39.00	16.34	42	
" Protein (Nitrogenous Matter),	15.27	305.40	183.24	60	
Non-nitrogenous Extract Matter,	38.24	764.80	497.12	65	
	100.00	2,000.00	696.74	–	

This grass is found quite frequently around barns and compost heaps as a weed. The analysis of the above sample shows strikingly the influence of a liberal manuring on the composition of the species of plants of which it is a variety.

CORN MEAL.

93.28 per cent. passed through mesh 144 to square inch, Sept , 1884.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.95	239.00	–	–	1 : 7.42.
Dry Matter, ...	88.05	1,761.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	1.59	31.80	–	–	
" Cellulose, . . .	2.59	51.80	17.61	34	
" Fat, ...	4.43	88.60	67.34	76	
" Protein (Nitrogenous Matter), . . .	13.13	262.60	223.21	85	
Non-nitrogenous Extract Matter, ...	78.26	1,565.20	1,471.29	94	
	100.00	2,000.00	1,779.45	–	

CORN MEAL.

91.4 per cent. passed through mesh 144 to square inch, August and September, 1884.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.40	248.00	–	–	1 : 9.25
Dry Matter, ...	87.60	1,752.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	1.66	33.20	–	–	
" Cellulose, . . .	2.71	54.20	18.43	34	
" Fat, ...	4.14	82.80	62.93	76	
" Protein (Nitrogenous Matter), . . .	10.77	215.40	183.09	85	
Non-Nitrogenous Extract Matter, ...	80.72	1,614.40	1,517.54	94	
	100.00	2,000.00	1,781.99	–	

SUGAR BEET PULP. (DIFFUSION MODE.)

[From the Franklin Factory.]

	Per Cent.
Moisture at 100° C.,	89.680
Dry Matter at 100° C.,	10.320
Organic Matter,	10 201
Ash,	0.107
Fat,	0.098
Crude Fibre,	2.450
Non-nitrogenous Extract Matter,	6.384
Nitrogenous Matter,	1.281

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	89.68	1,793.60	–	–	1 : 7.1
Dry Matter,	10.32	206.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.04	20.80	–	–	
" Cellulose,	23.74	474.80	474.80	100	
" Fat,	.95	19.00	19.00	100	
" Protein (Nitrogenous Matter),	12.41	248.20	248.20	100	
Non-nitrogenous Extract Matter,	61.86	1,237 20	1,237.20	100	
	100 00	2,000.00	1,979.20	–	

EXPERIMENTS WITH SPECIAL FERTILIZERS IN FRUIT CULTURE.

CURRANTS AND PEACHES.

The experiments with currants, which are described in the subsequent communication, are but a continuation of an investigation inaugurated upon the college grounds ten years ago.

Field experiments with sugar beets, for the purpose of ascertaining the influence of special fertilizers on the saccharine qualities, suggested the extension of the inquiry to fruit-bearing plants.

For the sake of brevity, and of a desirable understanding of the points involved, I reproduce here the introduction of one of the first publications on the subject under discussion: "The question whether a systematic and rational manuring of our fruit-bearing plants is essential for the continued production of good crops, engages more attention from year to year. Judging merely from the results obtained in general farm management, in consequence of the adoption of the rule to restore annually to the soil under cultivation, either the entire amount or in part, as circumstances may advise, those of its constituents which the crops carried off have abstracted, it seems but reasonable to assume that the same principle applied to the cultivation of fruit and garden crops in general, must prove in the end most advantageous, as far as quality and quantity of the crops resulting are concerned.

A liberal supply, in particular, of those essential elements of plant food which are found in the fruits in conspicuous quantities and for obvious reasons must serve important functions in their growth, if judiciously provided cannot otherwise but prove beneficial to the entire plant.

To secure that amount in a more definite form than as a general rule has been customary, improves most decidedly our chances to ascertain, not only the special wants of the plants under cultivation, but to recognize also the particular form in which the various elements of plant food exert their most valuable influence on the quality of the crops. Believing in the correctness of these views, I entered a few years ago upon a series of analytical chemical inquiries to determine the character of the ash constituents of fruits, and to study, also, the relations which apparently exist between the variations in the composition of the former and the quality of the latter, for the purpose of furnishing information needed for the *successful* introduction of a *rational system* of *fertilization* of our *fruit-bearing plants*."

These investigations have been carried on since without serious interruption, as far as the limited resources of past years for experimental work of that character have permitted. The scarcity of previous systematic chemical inquiries into the relations existing between the kind and the amount of available plant food in a productive garden soil or orchard, and the absolute and relative quantity of the various soil constituents contained in the fruit and garden crops raised upon it, rendered it necessary to grow them under well defined circumstances, to obtain material fit for comparative analyses.

The necessity of adopting that course of action became still more apparent, when considering the extraordinary influence — quite generally conceded — of soil, location and season on the quality of these crops. Products raised by the aid of different manurial substances, within the *same season*, upon a *similar soil*, and of a *corresponding stage* of *growth*, had to be secured for the examination, to impart a scientific and practical value to the analytical results.

It is a well-known fact that the *absolute amount* of the mineral constituents of plants of the same variety, and of one and the same species, even, may differ widely, yet, as a rule, this circumstance does not necessarily alter the general character of the plants.

A change, however, in the *relative proportion* of the various mineral constituents, as potassa, lime, etc., rarely has been noticed without having affected the quantity of some of the organic constituents, as sugar, starch, acids, etc.

The fact that the essential mineral constituents (potassa, calcium, magnesium, iron and phosphorus) of our farm plants cannot replace each other beyond a certain extent in the vegetable economy without endangering their life, points towards a *specific* function of each of them in the growth of these plants. We have learned, by experimental observation, what elements are indispensable for a healthy growth, and a successful reproduction of these plants. It remains for us, then, to ascertain the particular function of each of the above elements in the life of plants. The more we learn of the specific functions of each essential mineral constituent of plants, the better will we be prepared to perfect our system of manuring; to cultivate with a view of developing desirable qualities in the crops, and to counteract the serious influences of an abnormal composition of the sap, on the life of plants.

To secure suitable material for an examination in the above-mentioned direction, five experimental plats were set apart for that purpose in 1875. They were planted under the direction of Prof. Maynard, with strawberries, raspberries, currants and blackberries, besides cherry, plum, pear and apple trees. Four of these plats received, annually, a certain kind and amount of chemical manure (see currant experiments), while one plat received no manure. Upon each plat were planted the same kind and variety of fruits. Some interesting observations made on grape-vines and strawberries have been already published in the annual reports of the college, in the report of the Massachusetts State Board of Agriculture for 1879, and elsewhere. A brief description of experiments with healthy peach trees, and with trees suffering with "the yellows," has been published in the report of the Massachusetts Horticultural Society, and of the State Board of Agriculture for 1882. A more detailed description of these experiments, in particular, will be found in the annual report of the Board of Control of the State Experiment Station, for 1883. The experiments with currants, below described, furnish an interesting addition to previous observations.

EXPERIMENTS WITH CURRANTS.

Red Currants (Versailles).

The plants furnishing the fruits for the examination had been for several years under special treatment upon five different experimental plats. The ground upon which these plats are located has served, for years previous to its present use, for the production of grass. The soil consists of a light gravelly loam. Each plat covers an area of 4.2000 square feet; four of them have received, annually, for five to six years past, a definite amount and kind of special chemical manure, while one plat received none. The fertilizer was applied broadcast early in the spring, and subsequently incorporated in the soil by means of a cultivator. The plats were otherwise treated alike to secure a good mechanical condition of the soil, and to keep off the weeds.

FERTILIZERS APPLIED.

Plat I. received annually forty-five pounds of dissolved boneblack, containing from ten to twelve per cent. of soluble phosphoric acid, and fifteen pounds of potash nitre (saltpetre).

Plat II. received annually fifteen pounds of potash nitre and thirty pounds of kieserite.

Plat III. received annually forty-five pounds of dissolved boneblack, fifteen pounds of potash nitre and thirty pounds of kieserite.

Plat IV., nothing applied.

Plat V. received annually forty-five pounds of dissolved boneblack, eighteen pounds nitrate of soda (Chili saltpetre) and fifteen pounds of muriate of potash.

Nitrogen was applied in form of nitric acid, to secure a uniform action of that element.

Well-matured fruits were in every instance secured for the tests. They were collected July 18, 1883, and examined without delay.

One hundred parts by weight of the berries contained, —

	I.	II.	III.	IV.	V.
Dry vegetable matter,	13.76	13.61	15.72	12.95	13.86
Water at 100° C.,	86.24	86.39	84.28	87.05	86.14
Ash in dry matter,	.45	.45	.48	.41	.45

An examination of the composition of the berries showed the highest color, the largest amount of vegetable matter, and the largest amount of mineral constituents in the fruits from Plat III. The fruits from Plat V. rank next in regard to these qualities, yet exceed in sugar by more than one per cent.

The fruits from Plat IV. (without fertilizer) rank lowest in quality. The examination of the organic constituents of the berries will be repeated during the coming season, when more details will be published.

Ash Analysis of Fruit with Stems.

PLATS.	I.	II.	III.	IV.	V.
Sesquioxide of iron,	1.84	.99	.95	1.20	.75
Potassium oxide,	54.35	56.12	54.32	47.68	59.34
Sodium oxide,	5.42	2.35	2.56	4.02	4.04
Magnesium oxide,	4.10	5.08	5.49	6.23	4.61
Calcium oxide,	15.96	17.21	17.68	18.96	14.69
Phosphoric acid,	18.33	18.25	19.00	21.91	16.57
	100.00	100.00	100.00	100.00	100.00

The result of these analyses of the currants are calculated and reported with reference only to the several constituents mentioned in the above statement, for the purpose of rendering the variations in their quantitative relations more conspicuous. Other ash constituents, as sulphur, chlorine and silica, are for the present for various reasons excluded from the discussion. A careful consideration of the composition of the ash obtained from fruits raised upon the *unfertilized* plat (IV.), as compared with any of those obtained from fruits raised upon the *fertilized* plats, cannot fail to lead to the conclusion, that the unfertilized soil contained an ample supply of available phosphoric acid, magnesia, soda and iron; for even an actual addition of these important plant constituents, in the form of fertilizer, to the soil of Plats I., III. and V., failed to increase the quantity of these constituents above that found in the ash of fruits raised upon the unfertilized plat. The only ash constituent in which the unfertilized soil seems apparently to have been deficient, is available potassa.

An addition of potash compounds to the soil has in every instance increased the percentage of potassa in the fruits, varying from six to eleven and more per cent. The fruit gathered from Plat V. showed the most remarkable difference in that direction. Potash fertilizers have decidedly improved desirable qualities in the fruits; those from Plat V. proved the most saccharine.

Aside from the practical lessons which may be gleaned from the above described experiment, there is another feature of the analytical results deserving a serious consideration; namely, the *increase* of *potassa* in the currants is invariably accompanied by a *corresponding decrease* of phosphoric acid, and of *lime* in particular. This result coincides with my previous observations concerning the action of potash fertilizers on grapes, strawberries and peaches.

The circumstance that the most striking alteration in the mineral constituents of the currants has been produced by muriate of potash, seems to be of particular interest in connection with some of my previous experiments regarding the effects of that potash compound on *diseased peach trees.*

The examination of fruits and of young branches from peach trees affected by

"*The Yellows*"

disclosed the fact that they contained a large amount of lime, and more phosphoric acid than fruits and young branches collected from healthy peach trees of the same variety.

This condition of diseased peach trees has since been recognized by Dr. R. C. Kedzie, — on trees raised in Michigan, — in a letter to J. P. Leland, published Jan. 29, 1884, in the Allegan "Gazette."

It is also found, in our experiments, that a repeated application of muriate of potash, in connection with a judicious pruning, restored the affected trees to a vigorous growth, and the new branches and fruit to a normal amount of potassa, lime and phosphoric acid. The excess of lime disappeared in both fruit and branches, and the trees are reported by Prof. Maynard as restored to a healthy bearing condition.

The observations on currants (Plat V.) furnish an additional illustration of the beneficial effects claimed by me for the muriate of potash.

The importance of the interests involved renders a fair trial desirable elsewhere. The details of the mode of operation are published in the First Annual Report of the Board of Control of the Experiment Station. The director of the station has asked to be favored with information regarding the results obtained.

It is gratifying to be able to state that the treatment of peach trees, recommended on previous occasions, has been carried out extensively in various localities with many encouraging results.

MISCELLANEOUS ANALYSES.

ASPARAGUS.

	Stems.	Roots.
Moisture at 100° C.,	5.53	4.85
Dry matter,	94.47	95.15
Nitrogen in dry matter,	1 98	1.48
Insoluble in acids,	.08	3.67

One hundred parts of crude ash contained:—

	Stems.	Roots.
Potassium oxide,	42.94	56.43
Sodium oxide,	3.58	5.42
Calcium oxide,	27.18	15.48
Magnesium oxide,	12.77	7.57
Phosphoric acid,	12.31	15.09
Sesquioxide of iron,	1.22	Not determined

The examination has been carried on at the especial request of several garden farmers in the eastern part of the State. The plants serving for the analysis were raised upon the college grounds, upon a light, loamy soil, which previously had been occupied by grasses.

The comparatively small amount of soda in the ashes of both stems and roots confirms the impression that the beneficial influence of common salt on asparagus beds, not unfrequently reported, is due rather to its action on the physical condition of the soil than to its requirement as plant food. The common salt increases the hydroscopic quality of the soil, assists in the diffusion of potassa and phosphoric acid, and rarely supplies deficiencies in the soil, as far as its own constituents are concerned. A judicious application of muriate of potash, with sulphate of magnesia (Kieserite) tends to secure available potash throughout the entire body of the soil penetrated by the extensive root mass of the plants.

Analysis of the Ash of the Clinton Grape.

	A.	B.
Sesquioxide of iron,	.88	.91
Potassium oxide,	57.40	59.49
Sodium oxide,	3.51	59.49
Magnesium oxide,	7.24	7.50
Calcium oxide,	13.10	13.58
Phosphoric acid,	17.87	18.51
	100.00	100.00

Analysis of the Baldwin Apple (Matured).

One hundred parts of ash, soluble in hydrochloric acid, contained: —

Sesquioxide of iron,	1.08
Potassium oxide,	63.54
Sodium oxide,	1.71
Magnesium oxide,	5.52
Calcium oxide,	7.28
Phosphoric acid,	20.87
Insoluble in hydrochloric,	3.68

Analysis of the Ash of Corn Cobs (Longfellow Variety).

One hundred parts of cobs contained: —

Moisture of cobs at 100° C.,	12.00
Ash (crude),	1.38
Organic matter,	86.62

One hundred parts of the ash contained: —

Potassium oxide,	65.89
Sodium oxide,	2.94
Calcium oxide,	2.61
Magnesium oxide,	3.22
Ferric oxide,	1.16
Phosphoric acid,	5.44
Silica and sand,	18.74

The per cent. of potash present is as large as that found in many of our cultivated grapes.

Ash Analysis of Beet-sugar Molasses.

[From Roots grown on College grounds.]

Moisture,	5.27	
Potassium oxide,	24.60	per cent.
Sodium oxide,	15.84	" "
Magnesium oxide,	2.24	" "
Calcium oxide,	9.10	" "

Phosphoric acid,	trace.
Iron oxide,	1.44 per cent.
Silicic acid,	3.66 " "
Carbonic acid, chlorine, and sulphuric acid,	not determined.

As the molasses had been treated with boneblack, the phosphoric acid had been abstracted, and the relative proportion of other mineral constituents of the sugar beet, altered. The potash obtained from the molasses of the sugar beet is considered valuable for the manufacture of the finer qualities of glass. The beet-sugar manufacturer usually changes, by fermentation, the sugar of the molasses into alcohol; and evaporates the refuse of the still to dryness, and chars the refuse. The potash is abstracted from the charred mass in a similar way as from any other ash.

Ozone.

" *The most valuable article in the world.*"

[Prentiss Preserving Co., Cincinnati, Ohio. Sent on for examination by the "New England Homestead," Springfield, Mass.]

Moisture at 100° C. (including a trace of aromatic matter),	0.800 per cent.
Carbon,	6.080 " "
Ash,	.600 " "
Sulphur,	92.52 " "

The pretensions of the manufacturer regarding the value of this compound are not less strange than the name under which it is offered for sale.

The Phœnix Fruit Tree Invigorator.

(Manufactured by the Phœnix Fruit Tree Invigorator Co., of Livonia, Livingstone, County, N. Y.)

" *A specific for the Aphis on Fruit Trees and Berry Bushes of all kinds.*"
"*Patent Secured.*"

[Sent on for examination by the editor of the "New England Homestead," Springfield, Mass.]

One hundred parts of the material contained: —

Moisture at 100° C.,	21.75
Sulphur free,	41.25
Sulphur combined (with alkalies),	1.66
Sulphuric acid,	.64
Phosphoric acid,	.82
Chlorine,	.20
Carbonic acid,	9.54

Ferric oxide,	.68
Magnesium oxide,	1.13
Potassium oxide,	3.34
Calcium oxide,	14.08
Small quantities of soda with coal, etc.,	2.07
Ash constituents insoluble in acids,	2.84
	100.00

Claims of the Manufacturer.

"This compound, when applied to plants or trees, is taken up by the circulation of the sap, and carried by it to the leaves, where it is reorganized and distributed to all parts of the tree, giving the tree a healthy leaf, and a vigorous growth.

"Price, per pound box, $1.50."

Directions given by the Manufacturer for use.

"For Fruit Trees. Bore into the trunk of the tree, near the ground, with ⅝ bit till the heart is nearly reached; and fill the opening with the Phœnix Fruit Tree Invigorator, and close tight with a thin cork, or grafting wax. A wooden stopper may be used. Apply any time during the winter and spring, till the first of June.

"For Berry, Currant, Rose Bushes, and house plants. Remove the dirt and rough bark from the roots, and apply the invigorator, covering again with dirt."

The mode of applying the offered remedy for the destruction of insect life, and for the promotion of a healthful growth of plants, requires certainly a serious operation, and a first trial, if at all contemplated, ought to be carried out on a limited scale. The proposition to introduce the remedy directly into the circulation of the plant, is not without its analogy in the treatment of animals. One point, however, must be cheerfully conceded — the patentee means to get a liberal pecuniary compensation for his claimed discovery. A mixture of an essentially corresponding composition may be produced at an expense of from twelve to fifteen cents per pound, at retail cost, by taking from 40 to 42 pounds of flour of sulphur, and 58 to 60 pounds of sifted wood ash.

Analysis of a Bowel Stone discharged by a Horse.

[Obtained from Dr. Cressey.]

Moisture at 100° C.,	1.70 per cent.
Organic and Volatile Matter,	43.90 " "
Ash,	56.10 " "
Nitrogen (total),	1.455 " "

Phosphoric acid,	0.885	per cent.
Calcium oxide,	41.170	" "
Carbonic anhydride,	30.60	" "

One hundred parts contained: —

Moisture at 100° C.,	1.700	per cent.
Carbonate of lime,	69.546	" "
Tricalcic phosphate,	1.935	" "
Nitrogen containing organic matter,	26.819	" "
	100.000	

Analysis of a Urinary Calculus found in the Bladder of a Hog.

[Obtained from Dr. Cressey.]

One hundred parts contained: —

Moisture at 100° C.,	8.650	per cent.
Tricalcic phosphate,	10.981	" "
Carbonate of lime,	8.688	" "
Phosphate ammoniate of magnesia,	7.710	" "
Nitrogen containing organic matter,	63.971	" "

Diabetic Urine.

[Sent on for examination from Amherst.]

Specific gravity,	1.04	per cent.
Reaction (acid),		
Solids,	8.40	" "
Grape sugar,	6.95	" "
Mineral matter (in solids),	1.31	" "

Containing calcium, phosphoric acid, chlorine, potassium oxide, nitrogen, etc.

Sewage Water.

[Samples sent on by the Secretary of the State Board of Agriculture, John E. Russell.]

One hundred thousand parts contained: —

Solids,	1064.00	per cent.
Chlorine,	491.20	" "
Sulphuric acid,	71.23	" "
Phosphoric acid,	traces.	
Magnesium oxide,	57.29	" "
Calcium oxide,	20.20	" "
Sodium oxide,	182.98	" "
Potassium oxide,	5.50	" "
Total nitrogen,	8.34	" "
Nitrogen in free ammonia,	3.22	" "
Nitrogen in dry matter,	5.12	" "

This water contains considerable quantity of saline constituents peculiar to the water of the ocean.

VALUATION OF FERTILIZERS, AND FERTILIZER ANALYSES.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	Cents per Pound.			
	1881.	1882.	1883.	1884.
Nitrogen in ammonia salts, . . .	22½	29	26	22
Nitrogen in nitrates, ...	26	26	20	18
Nitrogen in dried and fine ground fish, .	20	24	23	20
Organic nitrogen in guano, and fine ground blood and meat, ...	20	24	23	18
Organic nitrogen in cotton seed, linseed meal, and in castor pomace, . . .	16	18	18	18
Organic nitrogen in fine ground bone, .	15	17	17	18
Organic nitrogen in medium fine bone, .	14	15	15	16
Organic nitrogen in medium bone, . .	13	14	14	14
Organic nitrogen in coarse medium bone,	12	13	13	12
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps, . .	11	11	11	10
Phosphoric acid, soluble in water, . .	12½	12½	11	10
Phosphoric acid, soluble in ammonia citrate,*	9	9	8	9
Phosphoric acid, insoluble in dry, fine ground fish, and in fine bone, . . .	6	6	6	6
Phosphoric acid, insoluble in fine medium bone, ...	5½	5½	5½	5½
Phosphoric acid, insoluble in medium bone,	5	5	5	5
Phosphoric acid, insoluble in coarse medium bone, ...	4½	4½	4½	4½
Phosphoric acid, insoluble in coarse bone,	4	4	4	4
Phosphoric acid, insoluble in fine ground rock phosphate, ...	3½	3	2¾	2¼
Potash as high-grade sulphate, . . .	7½	7	7	7¼
Potash as kainite, ...	5½	5	4¼	4¼
Potash as muriate, ...	4½	5	4¼	4¼

* Dissolved from two grams of phosphate, unground, by 100 c. c. neutral solution of ammonia citrate, sp. gr. 1.09 in 30 minutes at 40 deg. C., with agitation once in five minutes; commonly called "reverted" or backgone phosphoric acid.

The above trade values are the figures at which, on March 1, 1884, the respective ingredients could be bought at retail, for cash, in our markets in the *raw materials*, which are the regular source of supply. They also correspond to the average wholesale quotations.

The calculated values obtained by the use of the above figures will be found to agree with the reasonable retail price in case of standard raw materials, such as, —

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bones,
Plain Superphosphates.

The particular rate of valuation of each ingredient used for manurial purposes depends, in many instances, largely on its mechanical condition and its peculiar form of combination. For instance, in factory-waste, and animal and vegetable refuse of various descriptions.

It has been the aim in previous reports of the station to describe briefly, in connection with analytical reports regarding their composition, the peculiar character and special merits of prominent agricultural chemicals, and of refuse materials of various industries which are commonly used for the manufacture of compound fertilizers for farm purposes.

This feature of the reports will be retained for the future wherever an inducement is offered. The information thus far given on these occasions may be improved by studying the official annual reports on commercial fertilizers published for ten years past in the report of the Massachusetts State Board of Agriculture. A knowledge of the sources and of the character of the ingredients which serve largely for the manufacture of our commercial fertilizers, leads quite naturally to a due appreciation of the importance of securing the *proper form* for our circumstances. No mode of supplying our special wants of plant food for a successful and economical cultivation of crops is as safe as the practice to supplement, if needed, our home-made manures with commercial fertilizing ingredients, in the form of suitable raw materials and chemicals to meet our wants; and if obliged to increase our home resources of manure, to compound them from the most suitable stock in the market. Although a first trial of that course of action may not realize all the advantages expected, there can be no doubt about the correctness of the statement, that the best financial success on the part of the farmer can only be secured by the gradual adoption of that system of manuring the farms.

Our leading dealers in fertilizers begin to realize the late tendency in their trade, and are preparing to meet the call. There is every reason to assume that the consumption of chemical manurial matter will increase in the same proportion as the principles of a rational and economical system of manuring become better understood.

The results of an examination and a discussion of all fertilizers sold under a special license are reported according to our State laws, by the inspector, to the State Board of Agriculture, and will be found in the report of the Secretary of the Board for 1884.

Ammonium Sulphate.

[I. Collected of D. A. Horton, Northampton, Mass. Guaranteed 25 per cent. of ammonia.]

[II. Sent on for examination by M. W. Jefts, for the Ashby Farmers' Club, Ashby, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	1.88	0.42
Ammonia,	25.07	24.00
Valuation per 2,000 lbs.,	$90 64	$87 12

The cost of this article has varied widely at times; the valuation is based on our annual rate, 22 cents per pound of nitrogen in ammonia salts.

Chili Saltpetre.

[Collected at Amherst, Mass.]

Moisture at 100 C.,°	1.98
Nitrogen (in nitric acid),	14.44
Valuation per 2,000 lbs.,	$51 98

Muriate of Potash.

[I. Sent on by M. W. Jefts, for Ashby Farmers' Club, Ashby, Mass.]

[II. Collected of Boston Fertilizer Co., by C. P. Preston, Danvers, Mass.]

[III. Collected of Bowker Fertilizer Co., at Amherst, Mass.]

	POUNDS PER HUNDRED.		
	I.	II.	III.
Moisture at 100° C.,	1.00	0.05	0.90
Potassium oxide,	51.94	49.60	50.80
Valuation per 2,000 lbs.,	$44 15	$42 16	$43 18

This form of potash compounds has proved to be one of the most reliable potash resources for field and garden.

Kainite.

[Collected of D. A. Horton, Northampton, Mass.]

Moisture at 100° C.,	2.15
Calcium oxide,	.82
Magnesium oxide,	11.30
Potassium oxide,	16.48
Sulphuric acid,	21.91
Valuation per 2,000 lbs.,	$14 08

This is a fair sample of its kind. Potash, in form of kainite, has been applied with much success for forage crops. It deserves a careful trial upon pastures and meadows, in connection with bone fertilizers.

Refuse Salt.

[Collected of R. T. Prentiss, Holyoke, Mass.]

Moisture at 100° C.,	1.70
Calcium oxide,	1.21
Magnesium oxide,	.41
Sulphuric acid,	1.57
Sodium chloride,	95.38

The article is a fair specimen of its kind. A detailed discourse of the various kinds of salt used for agricultural purposes, etc., may be found in the annual report of the Massachusetts State Board of Agriculture for 1869, page 18.

Crude Kieserite.

[Of Randall Fertilizer Co., Boston, Mass. Sent on by C. P. Preston, Danvers, Mass]

Moisture at 100 C.,	28.12
Magnesium oxide,	17.45
Calcium oxide,	3.13
Sulphuric acid,	36.87
Insoluble matter,	3.62

The sample contained 48.6 per cent. of sulphate of magnesia, from 7 to 8 per cent. of gypsum, and 2.23 per cent. of chloride of magnesium; it is consequently of fair quality. The kieserite, as an absorber of ammonia, may profitably be used in many instances as a substitute for gypsum.

Nova Scotia Plaster (Gypsum).

[Collected of R. T. Prentiss, Holyoke, Mass.]

	Pounds per Hundred.
Calcium oxide,	32.17
Magnesium oxide,	1.40
Sulphuric acid,	44.00
Insoluble matter,	.70

The sample contains 94.8 per cent. of gypsum, and is a fair article. The customary market price in our vicinity is $9 per ton.

Onondaga Plaster (Gypsum).

[Collected of Sheldon & Newcomb, Greenfield, Mass.]

	Pounds per Hundred.
Calcium oxide,	29.15
Magnesium oxide,	3.89
Sulphuric acid,	31.82
Insoluble matter,	9.25

This article sells at $6 per ton; its cost corresponds well with its percentage of gypsum, — 67 to 68 per cent.

Onondaga Plaster.

[Collected of H. D. Fearing, Amherst, Mass.]

	Per cent.
Moisture,	22.25
Calcium oxide,	29.80
Magnesium oxide,	4.32
Sulphuric acid,	31.58
Carbonic acid,	8.80
Insoluble matter,	10.70

This sample contains a considerable amount of carbonate of lime, and resembles closely the previous one, where no special determination of carbonic acid has been recorded.

Lime-Kiln Ashes.

[I. Collected of R. T. Prentiss, Holyoke, Mass.]
[II. Collected of J. A. Sullivan, Northampton, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	30.70	20.55
Calcium oxide,	37.55	45.53
Magnesium oxide,	3.68	1.80
Potassium acid,	1.70	1.35
Phosphoric acid,	1.27	2.92
Carbonic acid,	17.83	21.10
Sulphuric acid,	–	–
Insoluble matter,	3.30	8.23

I. These ashes sold at 22 cents per bushel.

II. Sold at 18 cents per bushel at retail, and 12½ cents per bushel by the car-load. They consist in the main of a mixture of carbonate and slacked lime.

Wood Ashes.

[I. Ashes sent on for examination from Northfield, Mass.]
[II. Western ashes (leached) sent on for examination from Hingham, Mass., by Edmund Hersey, for the Hingham Agricultural and Horticultural Society.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	27.47	24.53
Calcium oxide,	30.50	26.53
Magnesium oxide,	2.81	3.03
Potassium oxide,	1.25	.79
Phosphoric acid,	1.98	1.89
Insoluble matter,	10.55	21.71

Wood ash ought to be bought and sold on guaranty of composition; inferior wood ashes are liable to come from all sections of the country.

The composition of the sample of leached ashes (No. II.) resembles closely that of a previously reported one from Detroit, Mich. (See Bulletin 5, No. 108; or First Annual Report, page 102.)

[I. Canada ashes, sent on by H. C. Haskell, of Deerfield, Mass.]

[II. Canada ashes, sent on by Edmund Hobart, North Amherst, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	15.37	28.57
Ash (dried),	84.63	71.43
Calcium oxide,	35.65	27.02
Potassium oxide,	3.64	5.06
Magnesium oxide,	2.38	2.75
Phosphoric acid,	2.11	1.07
Insoluble matter,	7.95	9 34

Ashes.

[Sent on by Messrs. John B. Moore & Son, Concord, Mass.]

	Per cent.
Moisture at 100° C.,	8.60
Calcium oxide,	35.80
Potassium oxide,	4.25
Magnesium oxide,	3.91
Phosphoric acid,	2.01
Insoluble matter,	16.08

Fertilizer.

[Sent on by W. H. Earl & Co., Worcester, Mass.]

	Per cent.
Moisture at 100° C.,	26.20
Ash,	28.15
Organic and volatile matter,	71.85
Calcium oxide,	20.59
Phosphoric acid,	.45
Nitrogen,	2.63
Insoluble matter,	1.95

As the nitrogen in this material is present in the form of leather refuse which has been treated with lime, no valuation is stated, as it must be valued by testing in the field.

Ground Horn.

[Of Perkins & Bradstreet, Danvers, Mass. Sent on for examination by J. J. H. Gregory, Marblehead, Mass.]

Moisture at 100° C.,	10.00
Organic and volatile matter,	95.00
Ash,	5 00
Phosphoric acid,	1.36
Nitrogen in organic matter,	13.53

Valuation per 2,000 Pounds.

270.6 lbs. nitrogen at 10 cents,	$27 06
27.2 lbs. phosphoric acid at 4½ cents,	1 22
	$28 28

The inferior mechanical condition of the article advises the low valuation of the nitrogen present.

Boneblack.

[I. Collected of B. F. Bridges, South Deerfield, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	1.55	2.50
Phosphoric acid,	30.54	23.47
Ash,	80.85	58.45
Calcium,	45.73	–
Valuation per 2,000 lbs.,	$27 49	$21 12

Boneblack refuse, in a fine ground condition may be profitably used for composting.

Ground South Carolina Phosphate.

[Sent on by the Ashby Farmers' Club, Ashby, Mass.]

	Per cent.
Moisture at 100° C.,	1.90
Total phosphoric acid,	27.13
Insoluble matter,	11.90
Valuation per 2,000 lbs.,	$12 21

The value of the phosphate last mentioned depends largely on its mechanical condition.

Dissolved Boneblack.

[I. Sent on by M. W. Jefts, for the Ashby Farmers' Club, Ashby, Mass.]

[II. Sent on for examination.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	11.05	10.50
Total phosphoric acid,	18.87	18.48
Soluble phosphoric acid,	17.83	16.18
Reverted phosphoric acid,	.53	.78
Insoluble phosphoric acid,	.51	1.52
Insoluble matter,	.83	.70
Valuation per 2,000 lbs.,	$37 26	$35 58

Lobster Shells.

[Sent on for examination by J. Shedd, 90 Waltham St., Boston, Mass.]

Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	.27

The material sent on consisted of coarse pieces of shells with meat mass in a dry condition. The large percentage of carbonate of lime present tends to promote a rapid decomposition of the organic nitrogenous matter, and favors thus a speedy action of the lobster shells, when dried and ground before their application. Counting phosphoric acid in the coarsely ground material 4½ cents per pound, and nitrogen 20 cents per pound, its commercial value would be from $22 to $23 per ton.

Ground Bones.

[Sent on by farmers near Bolton, Mass.]
[I. Coarse Bones.]
[II. Fine Ground Bones.]

	POUNDS PER HUNDRED.	
	I.	II.
Moisture at 100° C.,	5.67	5.68
Ash,	67.75	64.75
Total phosphoric acid,	27.17	25.90
Reverted phosphoric acid,	7.21	7.00
Insoluble phosphoric acid,	19.98	18.90
Nitrogen,	3.51	3.26
Insoluble matter,	2.28	.65
Valuation per 2,000 lbs.,	$45 00	$42 65

Penguin Island Guano.

[Sent on for examination.]

Guaranteed composition: Bone phosphate, 51.76 per cent. (equal to 23.07 phosphoric acid); ammonia, 1.43 per cent. (equivalent to nitrogen 1.18 per cent.).

Moisture at 100° C.,	12.10
Total phosphoric acid,	24.35
Soluble phosphoric acid,	.35
Reverted phosphoric acid,	6.97
Insoluble phosphoric acid,	17.03
Potassium oxide,	.14
Nitrogen in organic matter,	.23
Nitrogen in ammonia salts,	.26
Nitrogen in nitrates,	.24
Total nitrogen,	.73
Valuation per 2,000 lbs.,	$31 62

This article deserves a careful trial upon lands rich in organic matter; in particular, upon moist grass lands.

Cuba Guano.

[Sent on from Boston, Mass.]

One hundred parts contain : —

	Raw. Per cent.	Dried. Per cent.
Moisture at 100° C.,	36.57	22.57
Total phosphoric acid,	11.34	13.73
Soluble phosphoric acid,	.89	1.06
Reverted phosphoric acid,	3.52	4.45
Insoluble phosphoric acid,	6.93	8.22
Potassium oxide,	.94	1.20
Nitrogen (in organic matter),	.87	1.48
Nitrogen (in ammonia salts),	.14	.26
Nitrogen (in nitrates),	.64	1.00
Valuation per 2,000 lbs.,	$24 00	$34 49

Bat Guanos.

	Pounds per Hundred.			
	I.	II.	III.	IV.
Moisture,	25.47	61.90	72.38	7.80
Organic and volatile matter,	90.00	90.13	95.66	27.85
Ash constituents,	10.00	9.87	4.34	72.15
Total phosphoric acid,	4.43	2.28	1.00	2.04
Nitrogen (in organic matter),	5.66	2.21	2.32	.34
Nitrogen (in ammonia salts),	3.42	1.49	–	–
Nitrogen (in nitrates),	1.80	1.13	.34	.24
Potassium oxide,	1.31	–	–	–
Insoluble matter,	1.45	3.69	1.91	54.15
Valuation per 2,000 lbs.,	$48 34	$21 33	$10 80	$4 53

Fish Fertilizers.

[Sent on for examination from Danvers, Mass.]

[I. Claimed to be chemically prepared fish.] [II. Claimed to be clear fish waste.]

	POUNDS PER HUNDRED.	
	I.	II.
Moisture at 100° C.,	7.70	9.00
Total phosphoric acid,	8.15	11.72
Soluble phosphoric acid,	.67	–
Reverted phosphoric acid,	3.19	4.41
Insoluble phosphoric acid,	4.29	7.31
Potassium oxide,	.89	–
Nitrogen (in organic matter),	8.13	8.16
Insoluble matter,	14.65	3.70
Valuation per 2,000 lbs.,	$15 51	$19 35

Special Corn Mixture.

[Sent on by Gould & Co., Medfield, Mass.]

	Pounds per Hundred
Moisture at 100° C.,	7.82
Ash,	72.25
Total phosphoric acid,	18.09
Soluble phosphoric acid,	1.22
Reverted phosphoric acid,	1.61
Insoluble phosphoric acid,	15.26
Potassium oxide,	2.78
Nitrogen,	2.38
Insoluble matter,	8.40
Valuation per 2,000 lbs.,	$30 75

Garden Fertilizer.

[Sent on by farmers from Somerset, Mass.]

	Per cent.
Moisture at 100° C.,	6.64
Soluble phosphoric acid,	.70
Reverted phosphoric acid,	2.12
Insoluble phosphoric acid,	8.26
Total phosphoric acid,	11.08
Potassium oxide,	11.42
Nitrogen,	4 28
Insoluble matter,	.90
Valuation per 2,000 lbs.,	$39 49

Fertilizer.

[Sent on by F. J. Kinney, for the farmers near Worcester, Mass.]

	Pounds per Hundred.
Moisture at 100° C.,	7.15
Organic matter,	53.05
Ash,	46.95
Total phosphoric acid,	14.00
Soluble phosphoric acid,	11.26
Reverted phosphoric acid,	2.38
Insoluble phosphoric acid,	.36
Potassium oxide,	1.13
Nitrogen,	2.56
Insoluble matter,	.83
Valuation per 2,000 lbs.,	$38 17

Tobacco Fertilizer.

[Sent on by D. H. Dickinson, Hadley, Mass., through the Secretary of Hampshire, Franklin and Hampden Agricultural Society, Northampton, Mass.]

	Per cent.
Moisture at 100° C.,	14.65
Total phosphoric acid,	12.76
Soluble phosphoric acid,	2.97
Reverted phosphoric acid,	5.29
Insoluble phosphoric acid,	4.50
Nitrogen (total),	.77
Potassium oxide,	23.81
Sulphuric acid,	.89
Calcium oxide,	7.62
Carbonic acid,	3.20
Valuation per 2,000 lbs.,	$51 52

[I. Natural deposit from the West Indies. Sent on by "New England Homestead."]
[II. Fertilizer for French turnips. Sent on by "New England Homestead."]
[III. Fertilizer for round turnips. Sent on by "New England Homestead."]

	POUNDS PER HUNDRED.		
	I.	II.	III.
Moisture at 100° C.,	6.00	10.15	9.73
Total phosphoric acid,	29.53	7 35	6.50
Soluble phosphoric acid,	–	.86	.83
Reverted phosphoric acid,	10.28	2 59	2.29
Insoluble phosphoric acid,	19.25	3.90	3.38
Potassium oxide,	–	6.02	4.92
Nitrogen in organic matter,	–	2 28	2.24
Nitrogen in ammonia salts,	–	1.95	2.75
Total nitrogen,	–	4 23	4.99
Organic and volatile matter,	–	36.85	53.25
Ash,	–	63.15	46.75
Insoluble matter,	8.85	1.95	1.18
Valuation per 2,000 lbs.,	$35 83	$32 71	$34 06

Havana Tobacco Stems.

[Sent on by S. G. Hubbard, Hatfield, Mass.]

Moisture at 100° C.,	11 05
Dry matter,	88.95
Crude ash,	13.30
Nitrogen in dry matter,	2.91

One hundred parts of dry matter contained: —

Potassium oxide,	3.76
Sodium oxide,	.20
Calcium oxide,	4.15
Magnesium oxide,	1.53
Phosphoric acid,	.50
Sesquioxide iron,	.16
Valuation per ton of 2,000 lbs. for fertilizing purposes,	$14 28

The valuation is based on the prices of the past year (1883); it is safe to count one-tenth less at the prices of the present year.

Kentucky Tobacco Stems, Ground.

Moisture at 100° C.,	12.18
Dry matter,	87.82
Crude ash (in organic matter),	15.00
Nitrogen (in organic matter),	2.616
Chlorine,	.425
Sulphur,	.275
Potassium oxide (4½ cents),	8.816
Sodium oxide,	.161
Magnesium oxide,	1.395
Calcium oxide,	3.720
Phosphoric acid (6 cents),	.726
Insoluble matter,	1.618
Valuation per 2,000 lbs.,	$17 78

In this case the valuation is based upon prices current in 1884. Nitrogen has been valued at 18 cents per pound, phosphoric acid at 6 cents, and potash, 4¼ cents. Both of these refuse materials from the tobacco industry are quite valuable for manurial purposes.

Sumac. Waste Material from Tanneries in Peabody, Mass.

[Sent on for the Massachusetts Society for Promoting Agriculture.]

Moisture at 100° C.,	63.06
Organic matter,	36.94
Nitrogen in organic matter,	1.19
Crude ash in organic matter,	6.80
Calcium oxide in ash,	1.14
Magnesium oxide in ash,	3.25
Potassium oxide in ash,	.17
Phosphoric acid,	.17
Insoluble matter in ash,	2.25

The nitrogen, potash and phosphoric acid contained in the above article, represent a commercial value of $4.64 per ton of 2,000 pounds.

The tanning principle was so completely abstracted, that a composting with some air-slacked lime promises to render the material quite valuable as a manurial substance for light soils, deficient in organic matter.

Fresh Water Mud.

[Little Pond at South Braintree. Sent on by A. Drew, Esq., Boston, Mass.]

Analysis of a fairly dried sample : —

Moisture at 100° C.,	40.37
Calcium oxide,	1.27
Magnesium oxide,	.29
Potassium oxide,	.22
Ferric oxide,	1.80
Phosphoric acid,	.26
Nitrogen,	1.37
Insoluble matter,	18.26

The material in its natural state contains 72 per cent. water; in its composition it resembles a fibrous peat, yet it is less humified, and will yield its nitrogen, etc., more readily. One ton of the analyzed material represents a commercial value of from $5 to $6.

Salt Mud.

[Sent on by L. B. Goodwin, So. Duxbury, Mass.]

[I. Sample taken from a dock dug in a salt marsh. The sender states that large quantities of kelp have been unloaded at this dock, and a good deal of eel-grass is also deposited.]

[II. Taken from the flats at low-water mark.]

	I.	II.
Moisture at 100° C.,	46.36	60.37
Ash constituents,	49.28	33.09
Insoluble in acids,	43.55	26.20
Nitrogen in organic matter,	.39	.40

Soluble constituents contained: —

Sesquioxide of iron,	4.55	3.70
Calcium oxide,	.66	.90
Magnesium oxide,	.31	.43
Potassium oxide,	.33	.32
Sodium oxide,	.94	.94
Phosphoric acid,	traces.	traces.

Black Mud.

[III. From the flats near Weymouth, Mass. Sent on by Thomas A. Watson, Esq.]

Moisture at 100° C.,	56.55
Ash constituents,	39.60
Insoluble in acids,	31 84
Nitrogen in organic matter,	.30

Soluble constituents contained: —

Sesquioxide of iron,	4.26
Calcium oxide,	.91
Magnesium oxide,	.66
Potassium oxide,	.38
Sodium oxide,	.86
Phosphoric acid,	traces.

These three deposits of tidal water are of a similar composition. The amount of organic matter present does not exceed seven per cent., and the soluble mineral substances are mainly those found in the water of the ocean. The commercial value of plant constituents amounts, at present rates per ton of the deposits, in none of them to more than $1.75; in the last-named sample still less.

For those interested in the composition of the fertilizing material deposited and collected along the seashore, the following references are given: —

Kelp and Rockweed. See Report of State Board of Agriculture, 1878–79, page 347.

Rockweed and Musselmud. Report, 1879–80, page 338, 339.

Eel-grass. Report, 1882–83, page 407.

Analysis of Soil from a Diked Marsh at East Salisbury, Mass.

Moisture at 100° C.,	34.40
Organic and volatile matter,	92.15
Ash constituents,	7.85
Soluble part of ash,	4.20
Insoluble part of ash,	3 65
Nitrogen in organic matter,	1.64
Phosphoric acid in ash,	.13
Potassium oxide in ash,	.26
Calcium oxide,	1.24

ON EXAMINATION OF DRINKING-WATER.

One of the first requirements of success on a farm consists in ample supply of a good water. Purity of the water used, for drinking in particular, is of vital importance. Cities and towns usually have their organizations for the supply of water, and they exact certain guarantees regarding the quality furnished for their use. The farmer, living as a rule more isolated on his farm, is in this respect largely left to his own counsel. His chances for obtaining good water from springs, and for protecting his wells against the access of obnoxious matters by infiltrations and otherwise, are, in the majority of cases, quite favorable, if intelligently turned to account.

A satisfactory supply of a good drinking-water depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live stock; and on the personal attention bestowed, from time to time, on the condition of the latter and its surroundings. Wells may be badly located in the start, or may become exposed to contamination by subsequent changes in the surroundings. Good wells are liable to change for the worse at any time, on account of circumstances too numerous to state in this connection. To periodically ascertain the exact condition of the well which supplies the wants of the family and of the live stock, is a task which no farmer can for any length of time discard, without incurring a serious risk in health and prosperity. The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities, which an apparently good water may contain, are disguised, beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopical observations, are, in the majority of cases, the only reliable means, in our present state of the sciences, by which desirable information regarding the true character of a drinking-water can be obtained.

These tests, it must be acknowledged, although of the greatest importance from a general standpoint, have their limitations. They readily indicate the presence of organic matters, but give no unfailing decision regarding their origin, — whether animal or vegetable, — leaving thus, quite frequently, the degree of their harmfulness quite undecided. However, the chemical analysis may be depended upon for all practical purposes, as revealing the presence of objectionable qualities of the water.

The harmful substances found in drinking-water are of two classes, — mineral and organic. Few natural waters are entirely free from mineral matters; nearly all contain small quantities of lime, soda, magnesia and iron, — substances which may be considered harmless in that case. Larger quantities of these elements, however, render the water objectionable for drinking, and also more or less unfit for various applications, as washing and cooking, feeding of steam apparatus, etc.

Foremost among the dangerous mineral substances which have been found in drinking-water is the lead. Its presence is usually due to the use of lead pipes for conducting the water from the well to the pump, and elsewhere. Lead is a treacherous and dangerous poison. Not a trace should be tolerated in drinking-water. The use of lead pipes for conducting the latter for either of the above stated purposes should be strictly prohibited by State law. Arsenic and copper are rarely met with in natural waters; yet a careless handling of paris green is at any time apt to become most dangerous in this direction.

These three metals — lead, copper and arsenic — are direct poisons to the animal system, and therefore are the most dangerous mineral impurities in drinking-water, though ordinarily rare.

The most frequent source of danger comes evidently from the presence of organic matter, indicating contamination by decaying animal or vegetable substances. Wells are not infrequently found polluted by the gases and liquids emanating from sinks, privies, cesspools or barnyards, when apparent conditions would seem to render it impossible.

Much has been written on this subject, yet the necessity for constant warning still remains. No better illustration is needed than the analyses of the samples given below, which were taken, almost at random, in various parts of the State. These analyses have been made according to Wancklyn's process, familiar to chemists, and are directed toward the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals. (For a more detailed description of this method, see Water Analysis, by J. A. Wancklyn and E. T. Chapman.)

The hardness was determined by Frankland's method. (See Frankland's Water Analysis, page 29.)

The presence of chlorine indicates contamination from sinks, privies or sewers, since it occurs abundantly in urinary secretions; but it may be derived from other and less harmful sources, as saline waters, which the test fails to indicate. One conclusion is, however, safe: a water which contains no chlorine is uncontaminated by sewerage. "Free" and "albuminoid" ammonia are the forms in which organic matter is recognized. Ammonia, existing as such in water, is termed "free." This being expelled by distillation, the nitrogen containing organic matter remaining is reduced to ammonia by chemical agencies, and this secondary product is called "albuminoid ammonia."

The per cent. of total solids is obtained by evaporating a known quantity of the sample to dryness and weighing the residue.

Hardness, a rather arbitrary term, signifies that quality of water which prevents the ready formation of lather with soap. It is usually due to the presence of salts of lime or magnesia, which decompose the soap, forming new insoluble compounds. As long as these reactions occur no lather will be formed, consequently the quantity of a standard soap consumed before a permanent lather is obtained, indicates the amount of earthy salts contained in the sample, or its relative degree of hardness. Frankland's scale has been changed to Clark's, the latter being a more popular one.

Ten degrees of Frankland's scale are equivalent to seven of Clark's.

Mr. Wancklyn's interpretation of the results of his mode of investigation are as follows: —

1st. Chlorine *alone* does not necessarily indicate the presence of filthy water.

2d. Free and albuminoid ammonia in water without chlorine indicates a vegetable source of contamination.

3d. More than five grains per gallon of chlorine, accompanied by more than 0.08 parts per million of free ammonia and more than one-tenth parts per million of albuminoid ammonia is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4th. Eight one-hundredths parts per million of free ammonia and one-tenth parts per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5th. Albuminoid ammonia, over 0.15 parts per million, ought to condemn the water which contains it absolutely.

6th. The total solids found in the water should not exceed forty grains per gallon.

An examination of the subsequent results of analysis shows that one-half of the samples should be condemned.

ANALYSES OF DRINKING-WATER.

	Results in Parts per Million and Grains per Gallon (Imperial.)					Results Expressed in Parts per 100,000.				
	PARTS PER MILLION.		GRAINS PER GALLON.							
	Free Ammonia.	Albumonoid Ammonia.	Chorine.	Solids.	Hardness. (Clark's Degrees.)	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids.	Hardness.
Sample No. I.,	.02	.10	.2	Not det.	.89	.002	.01	.287	Not det.	1.27
No. II.,	.60	.48	Not det.	"	Not det.	.06	.048	Not det.	"	Not det.
No. III.,	.06	.26	"	"	"	.006	.026	"	"	"
No. IV.,	-	.14	2.30	"	2.46	-	.014	3.290	"	3.515
No. V.,	.03	.14	.50	"	Not det.	.003	.014	.714	"	Not det.
No. VI.,	2.41	.05	3.20	"	4.90	.241	.005	4.571	"	7.000
No. VII.,	1.51	.37	1.70	13.50	2.28	.151	.037	2.429	19.286	3.257
No. VIII,	.03	.16	.30	5.75	1.82	.003	.016	.429	8.214	2.600
No. IX.,	29.10	2 20	9.40	Not det.	Not det.	2.91	.220	13.429	Not det.	Not det.
No. X.,	3.20	.40	3.75	"	"	.320	.040	5.357	"	"
No. XI.,	.11	.16	.50	"	1.37	.011	.016	.714	"	1.957
No. XII.,	.01	.37	4.45	25.50	10.39	.001	.037	6.357	36.429	14.843
No. XIII.,	46.87	1.07	5.40	33.50	7.70	4.687	.107	7.710	47.857	11.000

No. XIV., ...	.04	.21	.60	Not det.	3.00	.004	.021	.857	Not det.	4.286
No. XV., ...	.06	.08	.60	3.00	1.73	.006	.008	.857	4.286	2.471
No. XVI., ...	.11	.15	2.70	Not det.	3.70	.011	.015	3.857	Not det.	5.287
No. XVII., ...	.72	.30	8.90	"	Not det.	.72	.030	12.714	"	Not det.
No. XVIII., ...	.10	.11	Not det.	13.00	2.73	.010	.011	Not det.	18.571	3.90
No. XIX., ...	.07	.30	4.00	24.00	5.00	.007	.030	5.714	34.286	7.143
No. XX., ...	.06	.15	1.70	5.41	2.91	.006	.015	2.429	7.729	4.157
No. XXI., ...	.05	.11	1.70	22.50	7.74	.005	.011	2.429	32.143	11.057
No. XXII., ...	.21	.20	1.30	9.00	2.55	.021	.020	1.857	12.857	3.643
No. XXIII., ...	.66	.36	7.50	60.00	13.00	.066	.036	10.714	85.714	14.571
No. XXIV., ...	.50	.36	14.50	83.00	16.50	.050	.036	20.714	118.571	23.571
No. XXV., ...	.34	.16	12.90	52.00	11.80	.034	.016	18.429	74.286	16.857
No. XXVI., ...	.01	.07	.70	Not det.	2.50	.001	.007	1.000	Not det.	3.571

METEOROLOGY.

The importance of meteorological data in connection with observations upon plants or animals is apparent to all. No conclusions based on such observations are firmly grounded until the conditions of temperature, moisture and sunlight have been duly considered. The weather, therefore, constitutes an important factor in all experiments with animal or vegetable organisms.

To supply these useful and necessary facts the station has provided itself with the ordinary meteorological instruments for measuring temperature, rainfall, relative humidity of the air, etc., uniform with those in use by the United States Signal Service. These comprise an ordinary exposed thermometer, hygrometer, maximum and minimum self-registering thermometers, and rain and snow gauges. The thermometers are of high, standard quality, of which the names of the makers — Messrs. J. & J. H. Green of New York, — are sufficient guarantee. These are placed in a small thermometer house, specially constructed for the purpose, with sides of open shutters, five feet above the surface of the ground, and at sufficient distance from any buildings or trees to allow free exposure toward all points of the compass.

Three times daily, at 7 A. M., 2 P. M., and 9 P. M., the temperature and relative humidity of the air, amount and direction of clouds, direction and force of wind, state of the weather, and amount of rain, if any has fallen, are recorded. In addition to these observations, the maximum and minimum temperatures for the previous twenty-four hours are recorded at 9 P. M. These tri-daily observations give a very complete record of meteorological phenomena.

The station has become a "voluntary observer" in co-operation with the Signal Service, and forwards to that deparment a duplicate record of observations for each month, receiving in return its Farmer's Daily Weather Bulletin, and publications. The bulletins are posted in a conspicuous place for the benefit of all who may choose to examine them, and upon the receipt of warning from the Central Signal Service Station of this district, a cold wave flag is displayed above the Station buildings. This method of forewarning the public of the approach of serious changes of temperature is easily understood and appreciated, and will, we believe, be of much local value in the spring and fall months.

A meteorological summary for Amherst, for 1884, is presented here, through the courtesy of Miss S. C. Snell, observer at Amherst College. It will serve a general purpose sufficiently well, though taken at a location and exposure differing from those of the Station by so much that appreciable differences in rainfall and extremes of temperature undoubtedly exist. A record of the rainfall at the Station for a part of the year bears out this supposition, as the following comparison shows: —

MONTH.	Rain at Amherst College.	Rain at Experiment Station.
	Inches.	*Inches.*
May, ...	2.02	2.02
June, ...	1.38	2 11
July, ...	3.75	3.98*
August, ...	5.10	4.21
September, ...	1.25	1.04
October, ...	2.40	2.06
November, ...	2.53	2.62
December, ...	–	–
Total for eight months, ...	–	–

Although the two places of observation are only about one mile apart, the monthly rainfall agreed in only one case, and in one instance (August) differed 0.89 of an inch.

This comparative record, incomplete as it is, strongly emphasizes the necessity of obtaining meteorological data in the immediate locality of the scene of the experiments.

Records from even an adjoining neighborhood do not answer the requirements at all, and this is especially true in a hilly, broken country like that surrounding Amherst.

The instruments above mentioned will therefore prove an important addition to our resources.

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* Incomplete.

METEOROLOGICAL SUMMARY FOR AMHERST, MASS., 1884.

[From the Records of Miss S. C. Snell.]

MONTH.	TEMPERATURE.			WINDS. PERCENTAGE FROM EACH QUARTER.				RELATIVE HUMIDITY.			Rain and Melted Snow.	Snow.
	Mean.	Maximum.	Minimum.	N.W. to W.	S. W. to S.	S. E. to E.	N. E. to N.	Mean.	Maximum.	Minimum.	*Inches.*	*Inches.*
January,	21.64	40.1	8.0	47	35	15	3	72	100	41	3.598	2.0
February,	30.86	46.0	5.1	39	20	30	11	77	100	22	4.623	9.5
March,	32.89	54.0	-	48	24	15	13	70	100	34	5.669	4.0
April,	46.69	70.3	31.2	43	18	14	25	63	93	22	2.491	10.0
May,	57.35	85.2	37.6	52	22	18	8	65	90	13	2.020	-
June,	69.10	92.5	50.0	27	36	35	2	69	95	27	1.383	-
July,	68.64	93.0	57.1	53	19	22	6	75	97	40	3.746	-
August,	69.25	92.4	48.8	40	25	32	3	79	-	-	5.095	-
September,	64.35	90.0	39.0	31	39	27	3	77	97	40	1.253	-
October,	50.27	78.2	26.5	48	26	15	11	74	97	33	2.395	-
November,	38.43	61.0	19.8	53	27	17	3	71	95	29	2.530	0.5
December,	30.00	57.0	10.0	53	14	21	6	40	100	-	5.576	11.5

ABSTRACT FROM THE WEATHER RECORD OF PROF. E. S. SNELL, OF AMHERST COLLEGE, AMHERST, MASS., 1836 TO 1885.

MONTHS.	1836.*		1837.*		1838.*		1839.*		1840.†	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	–	4.21	20.26	1.75	31.99	2.45	24.56	1.66	14.45	3.15
February,	–	3.83	26.69	2.42	19.55	1.67	29.79	1.75	28.50	2.03
March,	32 68	3.13	33.70	2.65	36.35	1.69	37.54	1.69	34.97	3.18
April,	47.27	1.98	47.42	4.33	40 72	2.02	52.18	4.14	48.95	3.98
May,	61.36	2.59	57.88	5.76	54.32	3.63	60.71	3.49	57.06	1.91
June,	66.37	3.45	68.15	4.49	68.63	4.90	65.40	3 30	65.50	4.60
July,	73.62	6.02	70.64	7.35	71.86	2.27	74.40	9.56	70.56	3.34
August,	68.00	0.96	68.61	2.57	68.16	3 95	70.74	2.51	70.26	6.82
September,	62.36	2.28	61.42	1.07	62.73	6.38	63.50	2.82	57.22	5.20
October,	47.88	3.02	49.97	2.06	46.53	4.12	53.32	1.78	47.39	5.04
November,	38.22	3.49	40.23	1.90	34.07	5.77	36.65	3.04	36.95	4 61
December,	29.24	5.80	27.62	2.35	23.52	0.96	28.93	7.09	23.61	3.15
Means and sums,	52.70	40.76	47.72	38.70	46.52	39.81	49.81	42.83	46.28	47.01

* Observations taken, for average temperature, at 9 o'clock, A. M. and 3 o'clock, P. M.

† Observations of average temperature taken at 7 o'clock, A. M. and 6 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1841.*		1842.*		1843.*		1844.*		1845.†	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	25.63	5.80	25.55	1.02	29.73	1.99	13.93	3.44	24.52	4.97
February,	20.20	1.50	30.50	3.78	16.48	3.49	22.07	2.18	24.86	3.37
March,	31.90	2.85	37.69	2.39	24.52	5.73	35.53	4.12	36.93	3.56
April,	41.63	4.52	46.50	2.92	44.63	4.82	51.95	0.57	45.59	1.70
May,	54.39	3.47	52.71	2.40	55.95	2.09	57.85	5.59	56.15	2.42
June,	68.35	1.65	64.10	3.18	65.28	5.18	65.55	3.00	66.71	2.57
July,	69.53	2.55	71.48	1.95	68.76	2.53	68.23	3.81	72.12	3.31
August,	69.82	3.18	69.05	7.42	69.81	9.38	68.00	4.93	71.54	2.79
September,	61.21	3.50	57.43	3.23	61.70	1.57	59.55	1.84	58.30	2.58
October,	42.81	3.73	47.44	2.84	44.98	9.45	47.55	6.49	49.64	4.66
November,	35.28	2.80	35.10	3.73	33.98	3.07	35.73	2.12	41.49	3.90
December,	29.50	6.08	24.18	3.19	27.97	2.28	27.28	2.49	21.53	3.91
Means and sums,	45.85	41.63	46.81	38.05	45.32	51.58	45.94	40.58	47.45	39.74

* Observations in temperature taken at 7 o'clock, A. M. and 6 o'clock, P. M.

† Observations in temperature taken at 7, 8 or 9 o'clock, A. M. and 6 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1846.*		1847.*		1848.*		1849.*		1850.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain Inches.
January,	24.75	2.74	25.50	4.86	28.95	2.92	20.02	0.99	25.90	4.75
February,	20.14	2.55	24.71	4.88	23.71	2.60	18.50	0.99	28.42	3.56
March,	36.33	4.35	29.24	3.57	32.63	3.03	35.37	4.21	32.43	1.86
April,	50.06	1.54	43.28	1.41	43.32	1.55	43.49	2.24	42.91	3.93
May,	58.29	4.33	57.48	1.91	59.47	6.18	53.42	3.61	53.38	8.72
June,	64.96	3.10	64.73	4.44	67.63	2.58	66.88	1.53	67.27	2.88
July,	70.66	3.25	72.42	4.48	69.45	4.72	72.09	2.25	72.08	6.81
August,	69.60	2.44	69.27	4.06	70.56	1.53	68.85	7.86	67.10	6.50
September,	65.48	0.47	59.30	3.63	57.43	2.49	60.05	1.40	59.40	4.93
October,	47.59	2.09	45.97	3.99	47.31	3.15	47.03	6.36	48.18	3.65
November,	43.05	4.96	43.15	4.17	33.49	3.09	44.08	3.65	39.95	2.63
December,	25.32	3.10	34.24	6.41	30.56	5.54	28.40	3.36	23.45	5.37
Means and sums,	48.02	34.92	47.44	47.81	47.04	39.38	46.52	38.45	46.71	55.50

* Observations in temperature taken at 7, 8 or 9 o'clock, A.M., and 6 o'clock, P.M.

Abstract from the Weather Record — Continued.

MONTHS.	1851.*		1852.†		1853.†		1854.‡		1855.‡	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	23.79	1.66	19.57	2.415	24.26	2.107	22.75	2.007	27.26	5 061
February,	27.89	5.08	25.17	3.349	26.72	6.686	21.96	4.530	19.83	2 702
March,	35.51	1.28	30.86	3 256	33.82	2.391	31.62	3.105	31.53	1 078
April,	46 20	4.43	39.44	4.711	44.02	3.786	43.47	8.328	43.83	3 845
May,	55 61	4.07	56.05	2.295	56.70	5.404	59.49	3.193	56.65	1.492
June,	63.60	3.69	65.38	2.544	66.97	2.636	66.67	1.751	65.04	5.191
July,	69.13	4.31	69.95	3.381	68.73	3.585	74.08	3.525	70.87	6.102
August,	66.20	3.03	65.16	5.190	67.84	7.126	68.82	0.988	65.53	2.553
September,	60.93	2.05	58.37	2.475	59.54	5.664	61.50	5.458	60.82	0.547
October,	51.04	5.43	49.31	1.763	46.84	3.747	51.53	2.305	49.73	10.078
November,	34.54	5.30	36.42	6.426	39.14	6.238	40.27	7.480	38.84	4.123
December,	20.13	3.17	32.85	4 876	26.31	1.834	22.29	2.390	28.21	5.499
Means and sums,	46.21	43.50	45.71	42.681	46.65	48.240	46.99	45.560	46.52	48.181

* Observations in temperature taken at 7, 8 or 9 o'clock, A.M., and 6 o'clock, P.M.
† Observations in temperature taken at 6 o'clock, A.M., and 2 and 10 o'clock, P.M.
‡ Observations in temperature taken at 7 o'clock, A.M., and 2 and 9 o'clock, P.M.

Abstract from the Weather Record — Continued.

MONTHS.	1856.*		1857.*		1858.*		1859.*		1860.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	15.24	2.483	13.54	3.547	28.81	3.519	22.94	4.887	26.52	1.210
February,	19.02	0.788	31.42	2.407	20.59	1.604	25.59	3.540	24.83	2.984
March,	25.88	1.118	31.08	2.121	31.31	0.795	36.74	6.272	37.19	1.582
April,	46.44	2.510	41.01	7.683	44.37	3.197	43.45	2.962	43.99	1.277
May,	53.58	5.313	55.19	6.818	54.10	2.981	59.19	4.076	57.29	4.573
June,	68.56	1.920	63.63	2.664	66.10	4.620	62.80	6.157	65.22	3.566
July,	72.93	1.955	70.87	4.982	69.80	6.726	67.73	2.607	66.39	6.125
August,	66.19	12.132	67.22	3.140	67.90	4.820	66.43	6.652	68.01	2.676
September,	60.79	3.472	59.90	3.039	50.90	4.135	57.10	4.466	56.78	6.115
October,	48.68	1.403	48.90	3.878	51.42	3.856	45.72	1.853	48.85	2.183
November,	37.47	2.847	39.46	2.069	33.91	2.158	41.07	2.960	42.70	3.521
December,	23.20	4.187	31.47	5.313	25.71	3.161	23.03	4.847	23.87	3.843
Means and sums,	44.84	40.128	46.14	47.661	45.40	41.572	45.98	51.279	46.80	39.655

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1861.*		186 .*		1863.*		1864.*		1865.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	20.45	4.342	22.31	5.253	29.08	5.053	24.36	2.200	18.73	3.483
February,	29.22	3 284	22.10	2.840	26.29	4.433	28.49	1.115	25.03	2.880
March,	32.49	3.759	32.17	4.298	26.13	5.602	34.40	2.578	37.12	5.980
April,	45.50	5.651	43.55	2.276	45.48	2.329	43.54	2.570	49.01	2.901
May,	53.37	4.449	58.13	2.325	55.35	3.587	60.41	2 541	57.13	7.892
June,	65.48	2.694	63.39	11.687	59.03	4.086	65.70	1.376	69.29	2.939
July,	69.46	5.229	67.98	5.117	70.87	8.636	71.49	0.964	69.06	3.719
August,	65.67	4.102	68.11	2.957	70.07	6.114	70.82	4.401	68.58	1.864
September,	59.93	2.751	61.06	2.118	57.38	2.163	57.84	2.924	65.62	0.373
October,	51.52	4.527	50.96	3.277	49.90	4.035	46.37	2.938	45.97	4.980
November,	37.82	3.981	39.56	4.757	41.06	5.278	38.04	6.197	39.91	2.453
December,	29.00	2.165	27.55	1.911	25.34	4.867	30.18	4.629	28.92	3.536
Means and sums,	46.66	46.934	46.41	48.816	46.33	56.183	47.64	34.433	47.86	42.980

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1866.*		1867.*		1868.*		1869.*		1870.*	
	Temp. F.	Rain Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	21.93	1.363	18 30	1.324	20.21	3.519	28.04	3.467	30.78	5.872
February,	26.18	4.617	31.23	3.646	18.21	1.030	28.01	4.137	25.34	5.247
March,	31.64	3.157	30.84	3.115	33.80	3.249	27.28	5.455	30.88	2.709
April,	48.63	2.031	45.49	3.791	41.96	4.270	46.45	1.532	48.26	3.701
May,	54.63	4.480	54.05	4.610	55.13	7.863	55.87	5.649	58.27	1.723
June,	65.82	5.660	67.06	5.672	66.17	2.441	64.72	5.986	70.45	2.728
July,	72.91	4.020	68.14	4.000	73.97	3.284	69.08	2.978	73.55	2.526
August,	63.48	3.955	68.56	9.161	68.97.	5.665	66.87	1.039	71.11	2.828
September,	60.00	4.713	59.99	1.107	59.47	10.633	62.06	4.318	62.32	1.752
October,	49.50	3.381	49.90	3.845	45.30	1.371	46.68	11.358	52.02	4.494
November,	40.10	3.859	37.87	4.305	36.48	4.796	35.92	2.591	39.10	3.278
December,	26.30	3.572	22.64	1.511	22.82	1.471	27.48	4.958	28.00	1.840
Means and sums,	46.76	44.808	46.17	46.087	45.21	48.590	46.54	53.466	49.17	38.698

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1871.*		1872.*		1873.*		1874.*		1875.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	23.27	1.960	25.11	1.507	20.56	5.013	28.15	5.461	16.73	2.896
February,	25.95	2.907	24.16	1.888	24.00	2.174	24.48	2.185	17 53	3.620
March,	40.53	3.988	25.27	2.870	30.64	3.176	32.93	1.348	27.79	4.200
April,	48.00	3.087	45.03	2.201	43.23	1.738	38.32	6.028	40.80	3.329
May,	57.84	3.815	59.14	3.110	54.58	3.910	56.52	5.224	57.14	2.188
June,	65.38	6.575	68.14	3.250	67.48	1.592	66.18	5.059	65.84	2.888
July,	69.18	3.523	72.64	7.066	71.30	2.927	67.16	11.579	69.30	8.149
August,	68.87	6.453	71.60	5.280	67.01	3.468	65.58	2.689	68.94	6.165
September,	52.84	1.302	61.70	6.197	60.35	4.765	62.03	1.818	57.27	4.649
October,	50.95	6.089	48.24	3.639	49.93	6.357	47.60	1.845	47.90	3.887
November,	34.03	3.507	36.43	4.483	29.68	3.509	36.21	3.536	33.11	3.974
December,	24.62	2.668	19.50	2.691	29.23	3.308	29.29	1.168	28.26	1.032
Means and sums,	46.79	45.874	46.41	44.182	45.67	41.937	46.21	47.940	44 22	46.977

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

Abstract from the Weather Record — Continued.

MONTHS.	1876.*		1877.*		1878.*		1879.*		1880.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Rain. Inches.	Temp. F.
January,	29.85	2.305	20.05	2.517	25.29	3.575	21.55	1.748	31.60	4.583
February,	26.36	5.526	30.78	0.360	27.14	3.665	22.37	3.490	29.09	3.600
March,	31.60	7.140	33.30	6.973	39.24	2.565	33.00	4.975	33.46	2.680
April,	43.60	3.105	47.80	2.452	52.17	5.853	43.18	3.847	47.54	2.640
May,	57.50	3.956	58.50	1.925	57.38	2.360	60.60	3.317	64.15	1.903
June,	70.61	3.867	67.77	4.587	64.73	6.003	66.26	5.365	68.52	1.401
July,	74.19	4.836	71.13	6.470	73.33	2.163	71.00	5.745	71.81	6.340
August,	70.54	0.272	71.35	2.790	68.63	6.974	67.19	5.885	67.53	2.908
September,	59.10	3.705	63.31	0.910	63.20	2.821	59.02	2.590	63.24	2.686
October,	45.50	1.118	50.50	6.985	54.43	2.054	56.01	1.800	47.27	2.269
November,	40.50	2.488	41.92	5.435	39.11	5.339	37.37	2.350	34.91	2.495
December,	19.70	3.217	33.09	1.023	28.95	6.020	30.83	4.848	22.79	2.287
Means and sums,	47.42	41.499	49.12	42.417	49.47	49.392	47.36	45.960	48.49	35.792

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

Abstract from the Weather Record — Concluded.

MONTHS.	1881.*		1882.*		1883.*		1884.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	17.92	4.011	23.57	5 436	21.00	3.243	21.64	3.598
February,	24.86	1.771	28.19	4.233	25.02	4.027	30.86	4.623
March,	35.20	4.859	35.13	5.200	27.26	1.700	32.89	5.669
April,	43.65	1.645	44.31	1 518	44.29	2.184	46.69	2.481
May,	61.70	4.281	52.86	6.498	58.60	6.195	57.35	2.020
June,	62.77	3.945	66.85	2.251	69.72	3.987	69.00	1.383
July,	70.64	1.501	71.89	1 829	70.42	3.691	68.64	3.746
August,	70.19	2.758	70.89	0.250	66.39	1.573	69.25	5.095
September,	67.35	2.368	63.23	11.846	59.43	3.174	64.35	1.253
October,	52.47	4.239	52.72	1.673	46.82	4.508	50.27	2.395
November,	40.30	4.578	36.45	1.330	40.43	1.800	38.43	2.530
December,	35.01	6.148	26.65	1.470	27.02	2.993	30.00	5.576
Means and sums,	48.70	42.104	47.73	43.534	46.36	38 875	48 29	20 369

Average yearly temperature from 1836 to 1884 inclusive, 46.578° F. Average yearly rainfall for same period, 43.532 inches.

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

ABSTRACT FROM THE PREVIOUS RECORDS,

PREPARED FOR SHORTER PERIODS OF THE YEAR, WHICH ARE OF SPECIAL INTEREST TO AGRICULTURISTS OF THE STATE; I. E., FROM THE 15TH OF APRIL TO THE 15TH OF JUNE, AND FROM THE 15TH OF AUGUST TO THE 15TH OF OCTOBER.

Averages of Temperature at 9 A. M and 3 P. M.

YEAR.	Last 15 Days of April.	First 16 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct
1836, ...	51.6°	61.9°	59 8°	67.6°	6.74°	63.3°	61.5°	48.9°
1837, ...	50.3	55.1	60.8	68.5	66.9	63.8	58.9	50.3
1838, ...	44.2	54.3	64.0	76.7	70.9	66.5	63.0	55.4
1839, ...	54.1	57.9	63.3	62.7	71.0	66.3	58.7	54.9
Averages of Temperature at 7 o'clock A M. and 6 P. M.								
1840, ...	53.93	50.8	63.8	62.8	71.3	60.3	54.1	51.3
1841, ...	46.2	47.6	62.0	67.1	68 2	66.1	60.5	45.5
1842, ...	49.4	48.8	59.5	60.8	69.7	63.5	51.7	51.2
Averages of 7 A. M. and 3 and 6 P. M.					*Averages of 8 A. M. and 3and 6 P M.*			
1843, ...	52.1	57.5	62.6	63.2	72.6	64.7	63.6	49.7
1844, ...	56.2	60.2	61.3	62.9	68.7	67.6	58.2	51.6
1845, ...	52.1	61.7	58.0	70.7	73.4	63.5	58.8	58.6
1846, ...	58.3	60.9	59.5	69.9	68.3	74.3	61.9	56.9
1847, ...	51.4	57.9	63.2	64.7	69.7	66.4	56.9	49.4
1848, ...	49.3	58.4	66.0	63.6	69.6	64.8	55.4	51.3
1849, ...	46.2	52.5	59.8	65.1	71.8	62.9	59.3	47.9
1850, ...	48.4	53.8	53.7	68.2	66.8	65.6	58.5	51.9
1851, ...	46.3	55.7	64.2	64.1	67.4	70.7	58.2	58.3
Averages of Temperature at 6 A. M. and 2 and 10 P. M.								
1852, ...	46.1	53.8	59.3	62.3	70.5	62.9	53.2	52.2
1853, ...	50.3	52.2	61.5	64.9	63.0	64.2	54 5	46.5

Abstract from the Previous Records — Continued.

Averages of Temperature at 7 A. M. and 2 and 9 P. M.

YEAR.	Last 15 Days of April.	First 16 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
1854,	46.3	57.3	61.9	66.2	68.1	64 7	54.2	55.1
1855,	49.7	55.2	58.5	60.9	62.8	63.2	58.4	57.3
1856,	51.6	49.7	57.9	64.6	62.2	63.0	58.6	52.4
1857,	41.2	52.7	57.9	62.2	64.4	65.9	53.9	53.6
1858,	42.2	55.3	52.9	64.2	–	66.2	54.8	52.7
1859,	41.7	58.2	60.1	59.5	63.2	57.2	57.0	52.6
1860,	43.3	58.7	59.1	64.0	71.3	58.8	54.7	46.5
1861,	49.2	51.3	55.6	64.4	60 8	60.9	60.9	55.2
1862,	49.2	55.9	60.5	62.9	64.6	62.8	59.3	56.2
1863,	49.4	53.9	63.2	61.8	66.3	62.9	53.8	52.1
1864,	47.4	58.8	62.1	61.8	66.1	57.9	57.8	48.8
1865,	51.1	54.5	59.9	67 6	65.0	71.3	60.2	52.2
1866,	52.4	54.4	54.9	62.1	61.6	63.3	56.7	50.3
1867,	47.9	50.9	57.3	65.8	66.9	61.9	57.2	49.6
1868,	48.2	51.6	58.9	63.3	68.8	65.9	53.1	50 5
1869,	54.7	53.8	58.0	62.4	68.0	63.1	61.0	54.3
1870,	49.9	56.4	60.2	67.9	68.9	62.0	61.9	55.6
1871,	48.7	54.2	64.6	67.4	67.4	58.9	52.1	55.5
1872,	49.7	58 9	59.4	63.8	69.9	62.9	60.4	49.7
1873,	45.0	51.1	60.9	64.4	64.6	62.3	58.4	50.8
1874,	39.4	53.3	60.4	64 5	63.6	65.4	59.2	49.2
1875,	40.4	51.2	64.8	62.8	67.7	63.8	51.1	47.5
1876,	45.7	53.9	61.3	68.2	67.6	61.2	56.8	46.3
1877,	51.8	53.6	63.3	67.9	72.4	65.1	61.5	54.3
1878,	55.9	56.1	59.2	60.7	67.1	68.2	58.6	56.4
1879,	49.8	58.5	62.7	65.7	65.5	63.8	54.2	61.4
1880,	50.4	59.7	68.9	64 7	67.3	65.7	62.9	51.6
1881,	51.1	59.7	60.4	59 9	69.0	67.4	67.1	58.0
1882,	46.8	49.7	56.2	63.8	66 9	65.6	60.9	54.7
1883,	42.9	50.8	62.1	69.4	66.7	67.0	58 5	49.9
1884,	51.3	54.1	61.1	66.6	65.9	67.6	61.1	54 2

Abstract from the Previous Records — Continued.

Rain.

Year.	Last 15 Days of April.	First 16 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
1836, ...	0.73	1.01	1.58	0.62	0.37	1.08	1.08	2.16
1837, ...	0.18	3.58	2.18	1.51	0.38	0.31	0.76	0.75
1838, ...	1.16	2.45	1.18	2.60	1.06	3.57	2.81	1.64
1839, ...	0.37	2.53	0.96	1.62	1.03	1.03	1.79	1.69
1840, ...	3.10	1.49	0.42	3.54	2.74	0.88	3.90	1.26
1841, ...	2.49	1.65	1.82	0.30	1.78	0.63	2.89	3.60
1842, ...	1.46	0.92	1.48	1.22	4.87	2.99	0.24	1.13
1843, ...	1.45	1.37	0.72	2.41	6.60	1.18	0.39	6.91
1844, ...	0.53	2.02	3.57	1.17	3.28	0.34	1.50	3.37
1845, ...	1.42	0.42	2.00	1.93	1.95	1.48	1.10	4.66
1846, ...	1.35	2.67	1.66	0.22	1.03	0.14	0.33	1.10
1847, ...	1.14	0.77	1.14	1.85	1.24	3.18	0.47	0.67
1848, ...	0.40	4.53	1.65	0.71	1.26	1.15	1.44	2.21
1849, ...	1.76	1.75	1.75	0.69	1.63	0.08	1.34	4.62
1850, ...	2.03	5.18	3.54	1.50	3.43	3.68	1.25	0.91
1851, ...	2.62	2.66	1.41	1.84	2.14	0.68	1.37	1.59
1852, ...	1.14	2.26	0.04	1.17	4.14	1.69	0.78	1.08
1853, ...	1.29	2.79	2.58	0.24	3.89	2.18	3.49	–
1854, ...	7.42	0.98	2.21	0.83	0.51	4.44	1.02	1.90
1855, ...	1.45	0.92	0.57	3.01	1.67	–	0.55	7.18
1856, ...	1.57	3.42	1.89	0.69	3.74	1.47	2.00	0.33
1857, ...	4.68	3.70	3.12	1.03	2.38	0.73	2.31	0.30
1858, ...	1.90	1.65	1.23	3.27	–	3.51	0.62	1.89
1859, ...	1.51	1.40	2.68	2.37	2.01	0.57	3.82	1.53
1860, ...	0.50	0.16	4.41	1.50	0.63	4.28	1.83	1.81
1861, ...	3.21	3.52	0.92	2.16	0.35	1.68	1.07	1.41
1862, ...	1.83	1.76	0.56	6.19	0.47	1.99	0.13	1.56
1863, ...	1.46	3.27	0.21	3.98	4.12	0.10	1.98	2.11
1864, ...	1.12	1.73	0.81	1.38	1.30	0.74	1.79	2.05
1865, ...	0.49	2.59	4.30	1.38	0.33	0.14	0.23	2.04

Abstract from the Previous Records — Concluded.

YEAR.	Last 15 Days of April.	First 16 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
1866, ...	1.54	1.12	3.38	2.94	1.38	1 28	3.43	0.07
1867, ...	2.80	2.56	2.05	2.72	1.15	0.52	0 59	2.32
1868, ...	1.59	3.64	4 23	1.62	0.65	5.53	5.10	0.67
1869, ...	0.96	3 48	2.17	0.82	0.11	1.18	2.95	10.04
1870, ...	2 71	1.07	0.66	1.13	1.90	0.25	1.51	1.97
1871, ...	2.28	3.53	0.28	2.88	5.12	0.73	0.57	5.13
1872, ...	0.33	1.24	1.82	1.63	3 48	1.01	5.19	1.48
1873, ...	0.55	3.13	0.78	0.34	2.30	1.63	3.14	3.30
1874, ...	4.51	1.62	3.61	1.59	1.90	0.08	1.74	1.78
1875, ...	1.10	1.66	0.33	1.38	2.66	0.81	3.84	1.44
1876, ...	0.52	2.09	1 27	3.43	0.27	0.61	3.10	0.67
1877, ...	1.92	1.12	0.81	3.02	0.35	–	0.91	4.93
1878, ...	4.19	1.48	0.88	2.47	1.62	2.28	0.54	0.33
1879, ...	2.86	1.47	1.85	2.79	4.65	2.21	0.38	–
1880, ...	2.28	0.37	1.53	1 16	1.72	1.70	0.98	–
1881, ...	0.59	0.95	3.33	2.01	0.97	1.13	0.14	1.43
1882, ...	0.89	2.67	3.83	0.76	–	3.81	8.04	0 73
1883, ...	0.55	1.38	4.81	2.33	1.57	0.44	2.73	1.95
1884, ...	0.95	1.09	0.93	0.58	4.69	0.38	0.88	0.50

RECORD OF FROSTS.

YEAR.	Last Frost in Spring.	First Frost in Autumn.	YEAR.	Last Frost in Spring.	First Frost in Autumn.
1836, . .	May 14, .	Aug, 10. Sept. 6.	1861, . .	May 29, .	Oct. 21.
1837, . .	May 29, .	Sept. 3.	1862, . .	May 25, .	Sept. 3.
1838, . .	May 18, .	Oct. 8.	1863, . .	May 16, .	Sept. 23.
1839, . .	May 4, .	Oct. 6.	1864, . .	May 2, .	Sept. 16.
1840, . .	April 28, .	Sept. 13.	1865, . .	May 13, .	Oct. 3.
1841, . .	May 20, .	Oct. 1.	1866, . .	May 15, .	Sept. 16.
1842, . .	May 21, .	Sept. 24.	1867, . .	May 13, .	Sept. 15.
1843, . .	June 1, 2,	Sept. 13.	1868, . .	May 12, .	Sept. 18.

Record of Frosts — Concluded.

YEAR	Last Frost in Spring.	First Frost in Autumn.	YEAR.	Last Frost in Spring.	First Frost in Autumn.
1844, . .	May 22, 23,	Sept. 24.	1869, . .	May 23, .	Sept. 1.
1845, . .	May 31, .	Sept. 13.	1870, . .	May 2, .	Sept. 12.
1846, . .	May 22, .	Oct. 4.	1871, . .	May 25, .	Sept. 21.
1847, . .	May 17, .	Sept. 16.	1872, . .	May 4, .	Sept. 4.
1848, .	May 1, .	Sept. 27.	1873, . .	May 31, .	Sept. 15
1849, . .	May 3, .	Sept 3.	1874, . .	May 23, .	Oct. 5.
1850, . .	May 22, .	Sept. 30.	1875, .	May 18, .	Sept. 12.
1851, . .	May 8, .	Sept. 15.	1876, . .	May 23, *	Sept. 28.
1852, . .	May 3, .	Sept. 17.	1877, . .	–	Sept. 22.
1853, . .	May 2, .	Sept. 30.	1878, . .	–	–
1854, . .	May 7, .	Sept. 21.	1879, . .	May 22, .	Sept. 21.
1855, . .	May 28, .	Sept. 20.	1880, . .	May 15, .	Sept. 24.
1856, . .	May 6, .	Sept. 25.	1881, . .	–	–
1857, . .	May 13, .	Sept. 7.	1882, . .	–	Oct. 4.
1858, . .	–	Sept. 25.	1883, .	–	Sept. 4.
1859, . .	May 16, .	Sept. 16.	1884, . .	May 29, .	Sept. 14.
1860, . .	April 27, .	Sept. 28.	–	–	–

* No frost 7 A. M. Temperature 41°.

	Last 15 days of April.	First 16 days of May.	Last 15 days of May.	First 15 days of June.	Last 15 days of Aug.	First 15 days of Sept.	Last 15 days of Sept.	First 15 days of Oct.
Average rainfall, .	1.73 in.	2.06 in.	1.86 in.	1.81 in.	2.02 in.	1.46 in.	1.84 in.	1.89 in.
Average temp., .	48.6°	57.0°	60.4°	64.9°	67.5°	64.3°	58.0°	52.4°

Average date of last frost in Spring, from 1836 1885, May 16th.
Average date of first frost in Fall, from 1836-1885, September 20th.

C. A. GOESSMANN, *Director*.

ASSISTANTS IN 1884.

Joseph B. Lindsey, Class '83, . .	Stock-feeding and Chemical Analysis.*
Charles H. Preston, Class '83, . .	General and Analytical Chemistry *
H. J. Wheeler, Class '83, . . .	General and Analytical Chemistry.
Winthrop E. Stone, Class '82, . .	Biology and Field Experiments.

* Messrs. Preston and Lindsey have since accepted more lucrative positions elsewhere.

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ANNUAL REPORT

OF THE

COMMISSIONERS ON CONTAGIOUS DISEASES AMONG CATTLE.

ANNUAL REPORT

OF THE

COMMISSIONERS ON CONTAGIOUS DISEASES AMONG CATTLE.

The Commissioners are able to report that no disease of a contagious character has visited *cattle* of the State during the current year. Many cases of lung disease have occurred, creating excitement, and arousing fears of the presence of the dreaded lung plague; but examination proved in each case that it was common pneumonia, or lung inflammation. There has been more disease than usual among our swine, and probably in consequence of the prevalence of hog cholera in some adjoining States great fear existed that it had found its way to our stock. The newspapers reported cases of the disease and severe losses thereby, but in every case reported to the Board and examined, it was found that the trouble was occasioned by other causes. Town or city officers have reported to us thirty supposed cases of glanders, and some cases have come to our knowledge where town officers have neglected to notify the Commissioners, and have themselves destroyed the diseased animals. Of those coming under our control, we have condemned and ordered killing in twenty-two. Owners of horses have quite generally become convinced that a glandered animal is dangerous, and when told by a veterinarian that one of their stock is thus diseased, they frequently destroy it, without notifying the authorities, and they would still oftener, were it not for the expectation that by notification they may obtain pay for the animal, or at least for killing and burying it; but as it is, it lessens somewhat the cases placed in our care, and shows the disease to be more prevalent than is indicated by the number we have condemned and killed. In the month of July the circus of O'Brien, from Philadelphia, commenced exhibiting in this State, with about one hundred horses. When in Ashburnham, our Board was notified of the number of horses belonging to the concern, and that glanders was among them. The veterinarian of the Board visited the place, but was unable to find a case of the disease, or the full number of reported horses. About the 20th of the month we were again notified of its being at Attleborough, and that glanders existed in the stock. A visit proved the fact, and seven animals were condemned and killed. Subsequent examinations were made when the exhibition was made at Franklin and at Great Barrington, but no disease was found, though animals were missing. This establishment, like others of its kind, travelled from place to place in rail cars of its own, and fed and watered all its animals on its exhibition grounds, but yet, if diseased, it was a source of danger to the public, in consequence of its street parades. Our experience with this concern should be a warning to municipal officers, leading them to refuse licenses to all similar affairs for exhibition, until they know that their stock is free from disease.

The Legislature of 1884 passed an act in May, increasing the duties of this Board, by requiring us to make an investigation in relation to the prevalence, cause and cure of abortion in cows. Early in July we prepared a circular which, after citing the law, was as follows: —

> "Knowing you to be personally interested in every effort to promote the interests of the farming community and the general public, we most earnestly ask your aid and co-operation in the assigned work, by reporting to us all cases of abortion which occur among the stock of your vicinity which are not the result of injury, that some member of our Board, or some expert employed by us, may visit the locality and make a minute examination of the same. We also request you to send us any facts or statistics in your possession, or which you can obtain, showing the extent to which the disease has prevailed during the last two or three years, and the probable annual loss thereby in the value of the stock and its products."

A copy of the circular was sent to each member of the Board of Agriculture, to the officers of all the agricultural societies, and to leading stock breeders of the State; but to date no reply has been received or case reported. Cases of epidemic abortion occur very rarely during the summer and when cattle are at pasture; and as the passage of the act was not generally known, and the circular not distributed until July, it is not surprising that no cases have been reported. This fact should not be accepted as positive evidence that none have existed. Stock owners—but especially those who deal to some extent in milch cows—are very reticent if there is any trouble with their herds, because, if known, it would damage the reputation of their stock and injure their business. It is a well-known fact that in previous years epidemic abortion has been of frequent occurrence, and we shall expect reports of cases during the period from the middle of the present month to the middle of April. The National Department of Agriculture has interested itself in work similar to that required by our statute, and its scientific experts will co-operate with this Board in investigation if any outbreak of the disease occurs. We desire to call the attention of the Legislature to a peculiar feature of the law for the suppression of "Contagious Diseases among Domestic Animals," and the difficulty which has arisen in relation to its equal and just administration. The law, as found in the "Public Statutes," may properly be said to be a codification of all the enactments on this subject, from 1860 to 1881, most of which were passed to meet great emergencies, and in after years modified and adapted to change or circumstances. A short review of this course of legislation may not be out of place here, and possibly it will indicate the defects of the law, if any exist, and show where, if at all, it needs amendment.

The disease known as contagious pleuro-pneumonia, brought to the State by two animals in 1859, had spread and assumed such alarming proportions in 1860 that the Legislature passed an act, April 4, authorizing "the Governor to appoint three commissioners to visit, without delay, the places where the disease existed."

It was mandatory, and required the Commissioners to kill and bury *all infected animals* — not only those which were sick, but also those which had been *exposed to the disease;* it directed them to "appraise all animals killed that did not appear to be affected by the disease, at their fair market value," which should be paid for by the State. This act was entitled, "An Act for the extirpation of the disease known as Contagious Pleuro-Pneumonia in Cattle." The Governor appointed the Commissioners, and they commenced their work; but soon reported to His Excellency that the disease had already covered such an extent of territory, and was spreading so rapidly, by the exchange and movement of cattle, that it was beyond their control, and suggesting an increase of their powers, and assistance by increasing the number of Commissioners, and the required co-operation of the municipal authorities. Between the time of the appointment of this Commission and the above-named report, the Legislature had adjourned; but the emergency was so great, that a special session was called, and, June 12th, an act was passed, making it the duty of the mayor and aldermen of cities, and the selectmen of towns, to take cognizance of all cases of contagious pleuro-pneumonia in cattle, gave them very large powers for the purpose of its suppression, required them to notify the Commissioners within twenty-four hours after they had knowledge of the existence of a case of the disease, if there was such a Board at the time, directed them to cause the slaughtered animals to be appraised in "their then condition," provided for payment of the damage, one-fifth by the town in which the animal was killed, and four-fifths by the State. Another act of the same date was passed, authorizing the Governor to increase the existing Commission to five persons, to appoint a scientific commission to investigate the special characteristics of the disease; and provided, that when the Commissioners were notified of its presence in any place, they should supersede the municipal authorities, and possess all the powers conferred upon those officers. An act passed April 25, 1862, provided that there should be an inspection of the cattle slaughtered, and such carcasses as were found to be healthy should be sold for beef, and the avails used to pay the appraisal of those animals. In administering these laws in 1860, as was clearly understood to be their intent and purpose, 710 healthy, but exposed, animals were killed and paid for, and 160 diseased were killed, and no compensation made. In 1862 one hundred and fifty-four were killed, of which number only seventy-seven were found healthy, and paid for. In 1864 the disease made its appearance among the cattle belonging to the city of Boston, on Deer Island; they were killed, thirty-four in number, only seventeen of which were found to be healthy, and for which compensation was made.

From 1860 to 1864 constant watch was kept, and effort made to "stamp out" this disease. Whenever one or more diseased animals were found in a herd, the whole herd was killed to prevent its dissemination to other herds, but no compensation was made for any but healthy animals. Feb. 28, 1878, an act was passed which said that "the selectmen of towns, the mayor and aldermen of cities, and the cattle commissioners of the Commonwealth, shall have and may exercise the powers, and shall be subject to the duties for the prevention of the diseases known as farcy and glanders among horses, asses and mules, and for the prevention of contagious and infectious diseases among domestic animals," as are conferred upon those officers by the law relating to contagious diseases among cattle. It also provided that the animals condemned and killed should be appraised in their diseased condition, by one of the Commissioners, a veterinary surgeon selected by the board, and a person selected by the owner of the condemned animal. Difficulties were met at once in administering this law. If the Commissioners had pursued the same course with this disease as was practised with pleuro-pneumonia in cattle, they would have killed *all* the exposed animals in a barn where only a part were actually diseased, and appraised and paid only for those killed which were in health. But in the opinion of the Commissioners the exigencies of the case did not require such wholesale slaughter, and following the advice of the Attorney General, only diseased animals were appraised, and in the manner provided by the law. In practice, it was soon found that this appraisal was little better than a farce, it often costing more to make the appraisal than was awarded for the diseased animal; and besides, it changed the intent and administration of the law as applied to the suppression of contagious pleuro-pneumonia among cattle, which, in the opinion of the Commission, the Legislature never intended.

Therefore, complying with the recommendation of the Commission, an act was passed in 1881, which said that in cases of glanders and farcy an animal that was condemned and killed by order of the *Commissioners* should not be appraised and paid for. Since that date the practice of the Board has been in accordance with this law. In codifying the laws in 1882 the general features of all these enactments were combined in chapter 90 of the Public Statutes, including the phraseology of the act of 1881. Prior to the passage of the last-named act, it was legal for both municipal officers and the Commissioners to appraise and pay for animals condemned as glandered; afterwards such a procedure was illegal only when done by the Commissioners. Whether this distinction was an oversight or an intent we would not decide, but it is certain that it results in great inequality and injustice. If the selectmen or mayor of a municipality neglect to perform their duty as required by the law, to notify the Commissioners within twenty-four hours after a case has come to their knowledge, and taking charge of it, condemn, appraise and kill the animal, the appraised value must be paid. Cases have arisen where this appraisal, under the management of selectmen, has been as high as two hundred and fifty dollars for an animal not fit to live, and which by its contagion was a menace to the community. This great inequality would be remedied by an amendment of section 16 of the Public Statutes, abrogating the power of selectmen, mayors and aldermen, as well as commissioners, to appraise and pay for glandered animals; and we recommend the proposed change to your consideration.

LEVI STOCKBRIDGE,
E. F. THAYER,
H. W. JORDAN,
Commissioners on Contagious Diseases among Domestic Animals.

BOSTON, Jan. 9, 1885.

[*Extracted from the Proceedings of the Essex Agricultural Society for 1884.*]

REPORT OF THE COMMITTEE

ON

FOREST TREES,

BY

JOHN ROBINSON, Chairman.

COMMITTEE;

BEN: PERLEY POORE, NEWBURYPORT.	J. P. CLEVELAND, BOXFORD.
J. D. W. FRENCH, NORTH ANDOVER.	G. L. HAWKES, LYNNFIELD.

JOHN ROBINSON, SALEM.

REPORT.

Three entries only were made this year, for the premiums offered for ornamental trees and tree plantations. These were by Oliver P. Killam of West Boxford, Romulus Jaques of West Newbury, and James Flint of Middleton. Neither of the entries exactly complied with the requirements of the premium list; yet inasmuch as the prospectus for the year was not sent out until after the time expired for entering trees, and as there were but three entries and no competition, your committee, after consulting with the president of the society, have thought it best to waive these technicalities and consider the trees entered upon their own merits; although they desire that this shall not be construed as a precedent for such action in the future, especially if there should be a larger number of entries and a decided competition. Your committee would here express their opinion that the prospectus of premiums should be more explicit, and that the rules in relation to the award of premiums be printed with each prospectus.

The trees entered are as follows: — "An acre of ornamental trees, bought six years ago, set out in the spring of 1879, on wornout pasture land, mostly Sweet Chestnuts," by Romulus Jaques of West Newbury, entered August 25; "A lot of shade trees," chiefly Rock Maples, entered by Oliver P. Killam of West Boxford, August 25; and a lot of shade trees, Rock Maples and White Pines, entered by James Flint of Middleton, September 4.

Members of your committee have examined all the lots entered, the chairman visiting each of them. The Rock Maples entered by Mr. Killam, are about 100 in number; they are well cared for, thrifty trees, varying from four to ten inches in diameter and from twenty to thirty feet in height. A portion of them — the larger trees — were set out about 1868, others in 1876, and when set all were cut down to poles. The longest row extends by a roadside, for about fifty rods, where the trees vary in density of foliage and deepness of color, according as the soil and moisture has affected them. Your committee consider Mr. Killam to be entitled to the premium offered "For best lot of any ornamental trees, set out on any street, road or farm, and cared for five years," and would recommend that such be awarded him.

The trees entered by Mr. Flint are fewer in number than the last, and do not evince so much care during their growth. It is very difficult to compare different species of trees with each other, in competition for the same premium, and as it is the opinion of your committee that the twelve White Pines, in the lot entered by Mr. Flint, are excellent specimens, they would recommend that a gratuity of $3 be awarded him, for good specimens of White Pines, planted by a road.

The trees entered by Mr. Jaques were supposed to be in competition for the "plantation" premium, and it would be difficult, under the circumstances, to admit them under "ornamental trees." They are Sweet Chestnuts, — a tree not included in the society's premium list, — about 400 in number, and are planted on the top of a hill, where the soil is rather poor. The trees vary some in size, but the larger portion, which occupy the centre of the acre covered, are about twelve or fourteen feet high, and three to four inches in diameter at the butt. They have been trimmed up to about six feet from the ground, and present a fresh and vigorous appearance. Your committee, to use the words of one of its members, was painfully impressed (as the wind was blowing a gale) with the necessity for shelter in young plantations by the introduction of evergreens, to be cut away as the progress of growth permits. They are, however, of opinion that the excellent condition of this plantation deserves notice, and would therefore recommend that a gratuity of $10 be awarded Mr. Jaques for well-cared-for plantation of Sweet Chestnuts.

The cultivation of forest trees has not until recently been looked upon as a necessity in this country, although it has long been of the utmost importance in Europe. The vast demands upon our forests, and the ruthless waste of timber-producing trees, added to the fearful losses by forest fires, and the premium offered for the destruction of the forests of the United States by the tax imposed upon Canadian lumber, at last has forced upon us the immediate consideration of this subject.

The greater question of national forests, however, is one with which, as a local agricultural society, we are hardly expected to deal, except so far as is our duty to educate the public to be prepared for the enactment and enforcement of laws for forest protection. In Massachusetts this has already been begun, by the passage of the statute exempting from taxation such lands as may be re-forested, and another statute by which greater penalties are inflicted upon those who, through carelessness, neglect, or with intent, set forest fires. This danger renders the risk of an investment in forest lands, which cannot be insured, so hazardous as to largely discourage what otherwise would be an important and profitable industry in this State, which is so well fitted for producing many species of valuable timber trees. Other duties, however, are before us; duties which every local agricultural society has to perform, and which this society has long ago recognized: the encouragement of small economic and ornamental plantations.

In making a proper choice of trees for this work, something more is required than a mere fancy for the varieties selected. It is necessary that we should know which species will endure the longest and be of the greatest benefit in years to come. If we fail here, disappointment results to ourselves and an injury is done to others who follow us; whereas, had our work been rightly performed at the outset, lasting benefits would be reaped. The distribution of trees on the surface of the earth is dependent upon the rainfall and temperature, locally varied by the condition and composition of the soil. It should be remembered, too, that by a long continued process of natural selection, nature has produced, for each and every region, the species and varieties of trees which are there best adapted to flourish. This should be carefully considered in making plantations, for any attempt to force trees to grow in uncongenial soil or climate is a crime against nature which she will not tolerate. Thus it will be seen that the question is not one of geography merely. We cannot say that a tree will flourish here solely because its native habitat is within our latitude, for other conditions are to be considered.

A glance at a map of the northern hemisphere, shows us that the configuration of the east coast of the continent of Asia is quite similar to that of eastern North America, and that in the Pacific ocean, as well as in the Atlantic, a warm ocean current commences at the southwest and, flowing across the ocean, disappears at the northeast. Therefore the coast climate of our continent closely resembles that of the other; the climate of northeastern Asia resembling that of New England and eastern North America, while that of California and Oregon is not unlike the climate of western Europe. There are, also, in various portions of the globe, certain conditions which tend to produce local climates quite different from the surrounding regions, and in some respects similar to our own.

Working with these facts, we may arrange in order the regions from which we are obliged to select trees for cultivation in New England, and beyond which, unless in rare, exceptional cases, it is useless to go to add to our collections.

The order is as follows * : —

First. The North Atlantic region of America, which includes New England and Canada, and extends southward to the mountains of northern Georgia and Alabama, and broadly to the eastern base of the Rocky Mountains.

Second. The eastern coast of Asia, north of about latitude 38, and including northern China, Manchuria and northern Japan.

Third. Regions with climates not sufficiently differing from that of New England to interfere with the adaptability of the plants of such regions to our climate. The central

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* These points are more fully treated in a paper by the present writer, read before the Mass. Horticultural Society, 1881.

Rocky Mountain region, portions of Siberia, the Caucasus, Turkestan, and possibly Thibet, are illustrations.

Fourth. To the plants from the regions already indicated, may be added certain cosmopolitan species, which inhabit widely different localities, and seem to flourish everywhere in the old world.

Of these the North Atlantic region, which includes our own local flora, possesses a variety of forest trees at least twice as great as is to be found on the whole continent of Europe, and trees, too, of acknowledged superiority, which have long been sought for and planted in foreign countries. These North Atlantic species have, for ornamental planting, the great advantage of producing those beautiful tints, the wonder and charm of our autumnal woods, while the trees of European introduction are brown and dull.

These trees require no introduction here. They include the Red, White and Rock Maples, the Basswood, Locust, Cherry, Tupelo, Cucumber Tree, the Ashes, Birches, the hardy Catalpa, the Elms, Hickories, Walnuts, a dozen Oaks, the Chestnut, and, among the conifers, the Red, White and Pitch Pines, Hemlocks, Firs and Cedars.

Among the trees most frequently planted here are many European species closely resembling their American relatives, but which, however, are not of lasting value. The climate of western Europe, as was previously mentioned, differs much from ours, on account of the great influence of the Gulf Stream, which mitigates the winter's cold and moistens the summer's heat, producing a climate more nearly resembling that of northern California and Oregon than our own. In fact, the trees of Oregon flourish well in the climate of England, where many of them have been introduced; whereas, with us, excepting a very few species, they would not survive a single season.

Among the European trees of frequent occurrence in cultivation here, are the Norway Spruce, Linden, Sycamore, Maple, English Oak, Scotch and Austrian Pines, European Ash, each of which has its respective superior in the American White or Blue Spruces, American Linden, Rock Maple, White and Overcup Oaks, White and Red Pines and White Ash.

Northern China and northern Japan having climates similar to our own, for similar reasons furnish many trees suited for our plantations, some of which have been successfully tried. The region of the Caucasus has furnished two excellent trees likely to continue of value, — the Picea orientalis and Abies Normaniana, — while others have been introduced from Siberia, Turkestan and Thibet. Among such trees we have the Horse Chestnut, which has proved itself exceedingly desirable for certain situations as an ornamental tree, possessing a stateliness unsurpassed by almost any other tree, and furnishing, too, a magnificent show of flowers in the latter part of the month of May.

Among the trees from the Pacific slope are some, however, which have such an extended range that, selecting specimens or seeds from the extreme limits of their dispersion, we are enabled to introduce them successfully here. Two such trees are the Douglas Fir and Picea fungens or the Blue Rocky Mountain Spruce. These trees, although not hardy when taken from California or when imported from Europe, have proved themselves perfectly hardy when introduced from Colorado. Specimens of both these beautiful trees may now be seen in the neighborhood of Boston, twenty feet high and of beautiful form and growth.

Of the European trees which succeed well in this climate may be mentioned the English and Dutch Elms, the European Larch, Norway Maple, and the White Willow. These species are of wide range, and seem to flourish in all regions. The English Elm has proved, for city streets, a better tree than the more graceful American Elm, although for suburban planting the American species has no equal. It is to be regretted that the desire for quick results has caused, in recent years, the use of the Maple to the exclusion of the Elm, in many of our villages, and the day is not far distant when those beautiful village streets with their arching Elms will be only known in picture and tradition.

The Norway Maple, while resembling our Rock Maple in general appearance, has a larger leaf and fuller, deeper green foliage, and for an ornamental tree is desirable, on account of its abundant yellow flowers which immediately precede the unfolding of the leaves in Spring. This tree, too, is particularly adapted for planting near the seashore. The White Poplar might also be mentioned in this connection, but its habit of extensively suckering renders it undesirable in most situations. The European Larch has proved itself better adapted to dry soil than the more meagre foliaged American species whose native habitation is in cold swamps. The last of these trees, the White Willow, is too well known to require mention; it has followed everywhere the settlement of the country, even to having the appearance in some places of a native species.

The ease with which European trees and seeds have been obtained, and the difficulty of procuring the seeds even of many desirable American species, has filled our nurseries with European trees to the exclusion of the American ones. Arboriculture has not long been considered scientifically, and no botanical garden hereabouts has been available for consultation and example. The planting of the Arnold Arboretum at West Roxbury is now well under way, and we may hope that the next generation, at least, of nursery men and tree planters will be able to reap the benefits of its object teachings. We are fortunate in having this living tree museum located so near us.

The value of certain timber trees is every year increasing, and bearing this in mind it would be well to select, for ornamental planting even, such trees as possess an economic value. Thus the White Ash should be planted in preference to other Ashes, the Rock Maple in preference to the Red or White Maple, the White and Burr Oaks to the Red Oaks, and the Red and White Pines to other coniferous trees. The Butternut, Black Walnut and White Hickory should have some of the objections to them waived, for ornamental trees, when we consider their value as timber-producing trees.

In making a plantation it should be borne in mind that trees require to have as much preparation of soil, and after care and attention, as cabbages or corn. Too often we see the tree planter snatch from some swamp or hillside, with roots exposed to wind and sun, the young trees he fancies are to return to him shade and comfort for his labor. Too often are they thrust into holes barely large enough to contain their roots, while they are left to care for themselves, or more likely die.

For ornamental plantations it is far better to purchase the trees outright of some reliable nurseryman, remembering that in this climate a northern nursery is the best from which to make such selections. For him who is to make an economic plantation, another source is available ; provided, however, that time is of less importance than money. He may purchase or raise his own seedling trees, which, after three or five years' care in nursery beds, may be finally set out in the plantations.

For ornamental trees, planted singly or in rows, the soil should most generally be removed to a depth of four feet, from a space some eight feet in diameter, unless the natural soil is particularly favorable. For the plantation on level ground, trenching to a depth of three feet will alone secure the best results. The time and money expended is well invested, for a large outlay in the beginning is often the cheapest and quickest way to insure the best success.

Two things are to be avoided : planting trees too thickly, and the improper mixing of species. The intermingling of different species in a plantation may be tolerated, and, under certain circumstances, is an advantage ; but, for ornamental planting in streets or roadsides, the effect is always best to adhere to one sort of tree.

Many otherwise fine streets in our cities and towns are ruined by the neglect of this rule, and even for lawns and yards it must be remembered that a few good specimens of two or three sorts is more dignified and satisfactory than a crowded array of different varieties. How many places are marked in our memory to-day by the recollection of one fine Elm, Horse Chestnut, Maple or Oak. It is not possible here to treat of many things which present themselves in considering this subject. The separate questions of soil, methods of planting, treatment of hillsides and of rocky lands, each require a volume for themselves. The subject of tree pruning, too, is one of as much importance as tree selection or tree planting, and for success in either a knowledge of structural botany is of immense assistance. But, after all, the most depends upon the intelligence of the arboriculturist himself; a bright, thoughtful, studious man will work out for himself far better results than rules laid down in books can do for him. Let him, therefore, ground himself thoroughly in the subject before he commences his work, perhaps by spending a winter in the study of plant life and structure; for when he works with a knowledge of his subject, his work will be well done.

An appendix has been prepared to this report, giving a list of a dozen books which may be read with profit by the tree planter, and also lists of a few good trees for plantations, roads and lawns.

Respectfully submitted, for the committee,

JOHN ROBINSON,
Chairman.

SALEM, Oct. 16, 1884.

APPENDIX

TO

REPORT ON FOREST TREES.

[A.]

A few books which may be read or consulted with profit by the tree planter.

Gray's Structural and Systematic Botany. Part I., especially chapters I. to VI., and chapters X. and XI. "The Botanical Text Book," a later edition of this work by the same author, has recently been published. Chapters I. to III., and VII. and VIII. cover about the ground of the above. To study either of them carefully throughout will be profitable. Students desiring to pursue the subject further may use Bessey's "Botany for High Schools and Colleges," Thome's "Structural and Physiological Botany," and Sach's "Text Book of Botany."

Man and Nature, by George P. Marsh, or a later edition of the same work entitled "The Earth as Modified by Human Action," octavo, 656 pages, New York, Scribner, Armstrong & Co. This is a classical work, and the chapters on forests and kindred topics are full of interest and information.

A Treatise on the Theory and Practice of Landscape Gardening adapted to North America, by Andrew J. Downing, octavo, 575 pages.

Trees and Shrubs, Hardy Native and Introduced, of Great Britain, by James Loudon, octavo, — pages, London. This is an abridgment of a work in six volumes by the same author. It gives descriptions of species and is fully illustrated.

Michaux's North American Sylva, three volumes and supplement to the same, by Nuttall, gives descriptions and finely colored plates of the forest trees.

Trees and Shrubs of Massachusetts, by George B. Emerson. First edition printed as a State report, 1846, one vol., octavo. Last edition, with colored illustrations, two vols., Boston, Little, Brown & Co., 1875.

Practical Forestry, by Andrew S. Fuller, octavo, 299 pages, New York, Orange Judd & Co., 1884, illustrated.

The Elements of Forestry, by Franklin B. Hough, octavo, 381 pages, Chicago, Robert Clark & Co., illustrated.

The Forester, by James Brown, octavo, 835 pages, London, illustrated.

Book of Evergreens, by Josiah Hoopes, small octavo, 435 pages, New York, Orange Judd & Co.

A Treatise on Pruning Forest and Ornamental Trees, by A. Des Cars, introduction by Prof. Charles S. Sargent, small octavo, 67 pages, illustrated. Published by A. Williams & Co. for Massachusetts Society for the Promotion of Agriculture. This little volume should be in the hands of every one who has occasion to prune trees.

The London Journal of Forestry, which is taken at some of our libraries, contains much valuable information for American tree planters. The Massachusetts State Agricultural Reports contain papers of importance by Sargent, Clarke and others, and portions of nearly all of the horticultural publications are now devoted to forestry.

For information in relation to strength of timber, the reader may consult *Timber and Timber Trees*, by Thomas Haslett, London, Macmillan & Co., 1875, octavo, 352 pages, illustrated.

The forthcoming Forestry report, a publication of the 10th Census of the United States by Prof. C. S. Sargent, will contain full descriptions of all the North American trees, some 400 in number, with maps of distribution, statistics of strength of timber, amount of ash, etc., etc. This will be a work of great practical value for consultation.

Insects Injurious to Forest and Shade Trees, by Prof. A. S. Packard, octavo pamphlet, 275 pages, being Bulletin No. 7 of the U. S. Entomological Commission, Washington,

1881. This can be obtained of Jas. Anglim & Co., 1424 F St., Washington, D. C., who makes a specialty of obtaining U. S. publications.

[B.]

TWENTY GOOD TREES FOR PLANTATIONS.

Acer saccharinum (Rock or Sugar Maple).
Robinia Pseudacacia (Locust).
Fraxinus Americana (White Ash).
Catalpa speciosa (Western Catalpa).
Juglans cinerea (Butternut).
Juglans nigra (Black Walnut).
Prunus serotina (Black Cherry).
Carya alba (Shagbark Hickory).
Carya sulcata (Western Hickory).
Quercus alba (White Oak).
Quercus macrocarpa (Overcup or Burr Oak).
Castanea vulgaris, var. Americana (Sweet Chestnut).
Fagus ferruginea (Beech).
Tsuga Canadensis (Hemlock Spruce).
Chamæcyparis sphæroidea (White Cedar), for swamps.
Pinus strobus (White Pine).
Pinus resinosa (Red Pine).
Pinus rigida (Pitch Pine), for sandy places.
Pseudotsuga Douglasii (Douglas Fir).
Larix Europæa (European Larch).

[C.]

FIFTEEN GOOD TREES FOR ROADSIDES.

Acer saccharinum (Rock or Sugar Maple).
Fraxinus Americana (White Ash).
Tilia Americana (Basswood).
Ulmus Americana (Elm).
Carya alba (Shagbark Hickory).
Quercus alba (White Oak).
Quercus Muhlenbergii (Chestnut Oak).
Quercus coccinea (Scarlet Oak).
Quercus tinctoria (Black Oak).
Castanea vulgaris, var. Americana (Sweet Chestnut).

Ulmus campestris (European Elm), for city streets.
Ulmus montana (Dutch Elm).
Acer platanoides (Norway Maple), near the seashore.
Populus alba (Silver Poplar), near the ocean.
Salix alba (White Willow), damp places and seashore.

[D.]

THIRTY GOOD TREES FOR LAWNS, PARKS AND SINGLE SPECIMENS.

Magnolia acuminata (Cucumber Tree).
Liriodendron tulipifera (Tulip Tree).
Æsculus flava (Sweet Buckeye).
Acer dasycarpum (White Maple), near water.
Acer rubrum (Red Maple), for low lands.
Pyrus coronaria (American Crab Apple).
Gymnocladus Canadensis (Kentucky Coffee Tree).
Catalpa speciosa (Western Catalpa).
Nyssa multiflora (Tupelo), near water.
Sassafras officinalis (Sassafras).
Fraxinus quadrangulata (Michigan Ash).
Ulmus fulva (Slippery Elm).
Ulmus racemosa (Rock Elm).
Quercus species (Oaks).
Ostrya Virginica (Hop Hornbeam).
Betula papyracea (Canoe Birch).
Pinus resinosa (Red Pine).
Tsuga Canadensis (Hemlock Spruce).
Picea alba (White Spruce).
Picea pungens (Blue Rocky Mountain Spruce).
Pseudotsuga Douglasii (Douglas Fir), from Colorado.
Pinus ponderosa, var. scopulorum, Rocky Mountains.
Morus alba (White Mulberry).
Æsculus Hippocastanum (Horse Chestnut).
Quercus cerris (Turkey Oak).
Pinus densiflora, from China.
Gingko biloba (Gingko Tree).
Picea orientalis, from the Caucasus.
Abies Normaniana, from the Caucasus.
Larix Europæa (European Larch).

[E.]

TWENTY GOOD TREES OF LESSER GROWTH, SUITABLE FOR SMALL PLACES AND YARDS.

Magnolia, several American and two Chinese species.
Cladrastis tinctoria (Yellow-wood)
Cercis Canadensis (Red-bud).
Cratægus (Hawthorns), several American species.
Halesia tetraptera (Silver-bell Tree).
Chionanthus Virginica (Fringe Tree).
Castanea pumila (Chinquapin).
Betula alba, var. populifolia (White Birch).
Tamarix Chinensis (Chinese Tamarisk).
Acer Tartaricum, var. Ginnala (Fragrant Maple).
Acer polymorphum, and other Japanese Maples.
Pyrus spectabilis (Flowering Apple).
Caragana arborescens.
Acer Pennslyvanicum (Striped Maple).
Acer circinatum (Round-leafed Maple).
Acer campestre (Field Maple).
Salix lucida (Shining Willow).
Chamæcyparis retinosporas, several varieties.
Juniperus Chinensis (Chinese Cedar).

ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

1885.

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT,
BOSTON, Jan. 20, 1885.

To the Honorable Senate and House of Representatives:

I herewith transmit to you in writing the twenty-second annual report and catalogue of the Massachusetts Agricultural College, and respectfully invite your consideration of the same.

GEO. D. ROBINSON,
Governor.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, Jan. 18, 1885.

To His Excellency GEO. D. ROBINSON:

SIR, — I have the honor herewith to present to your Excellency and the Honorable Council the Twenty-second Annual Report of the Trustees of the Massachusetts Agricultural College.

I am, sir, very respectfully,

Your obedient servant,

JAMES C. GREENOUGH,
President.

ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

To His Excellency the Governor and the Honorable Council:

The last year has been, in many ways, a successful year to the college. The standard of scholarship has been raised, the course of study has been extended, buildings and grounds have been improved, new buildings have been erected, an excellent class of young men has been in attendance, and good health, good cheer and a determination to accomplish good results, have characterized those in charge of the practical work of the several departments, the students and the faculty.

BUILDINGS.

The appropriation of $6,000, made by the last legislature for the repair and improvement of North College and "other buildings of the college," was very timely, and, under the direction of the building committee of the trustees, O. B. Hadwen, Esq., of Worcester, J. H. Demond, Esq., of Northampton, President Greenough, and Hon. Daniel Needham of Groton, the money has been carefully expended. Throughout the first three stories, with the exception of two rooms previously repaired, — one occupied by the Christian Union, the other by one of the literary societies of the college, — the entire wood-work has been removed, and new wood-work substituted. This, well finished and covered with oil and shellac, has a very neat and cheerful appearance. In the fourth story, the rooms were most thoroughly repaired and painted, with the exception of three rooms previously fitted up. New floors have been put down throughout the building wherever needed. Twelve new windows have been added, thus securing ample light to all the rooms in the first three stories. The original treatment of the roof rendered it impracticable to add windows to the inner rooms of the upper story; but the position of these rooms makes additional light less needful than for those in the lower stories. Two rooms on the first floor of this building have been arranged for the present as library rooms. The roof of the boarding-hall has been shingled and the rear annex covered with tin. The dining-room has been reconstructed, and other improvements have been made in the building and in the drainage. We have also provided a much needed barn for the botanic department. The appropriation made to complete the house to be occupied by the president has been expended for that purpose, and the house is now occupied by him.

The library and chapel building, for the erection of which twenty-five thousand dollars was appropriated, is in a fair way to be completed on or before the first of July next. The walls are for the most part finished, and the roof is being put on. To make provision for what is required in this building, and to build of stone or brick according to the act making the appropriation, and still to keep within the limits of the appropriation, we have found a difficult task. After several meetings of the building committee, the architect and contractors, a contract for the erection of the building was made with John Beston of Amherst, a builder of large experience and excellent reputation. Stephen C. Earle, of Worcester, is the architect. While we expect to be able to put up the main part of the building and complete it, within the appropriation, we find ourselves obliged to omit most of the tower. With our present means we shall be compelled to finish the tower with a roof after it reaches a sufficient height to form an entrance. The group of college buildings, as well as this building, requires this tower. No one visiting the grounds will be satisfied with this library and chapel building in the imperfect state in which we are now obliged to leave it. The design of the architect should be carried out, that we may have a place for the college bell and for the college clock. The evident determination of one of the classes now in college to provide an excellent clock, if the tower is now built, and the fact that the building can now be perfected at less expense than hereafter, are important arguments for finishing the building as designed. We could not make the building smaller and have it suffice for the purposes intended; hence our effort to keep within the appropriation and secure the rooms needed, though unable to perfect the building. An appropriation will be needed at an early day to furnish this building, and to do what is needful to perfect the building according to its plan. As soon as it is furnished with shelving and cases, our library and our more valuable geological and other specimens will be transferred to it. This building is of granite, from the Pelham quarry, belonging to the college. On the sixth of last November the corner-stone was laid. His Excellency Gov. Robinson, *ex-officio* President of the Board of Trustees, being unable to fulfil his intention to be present, Hon. J. S. Grinnell, of Greenfield, presided. The reasons for erecting the building were briefly outlined by President Greenough. He referred to the action of the alumni at their annual meeting in 1883, when measures were taken to provide a better library for the college, — to the request of the Board of Control for the use of the present chapel-room for a laboratory for the Massachusetts Experiment Station, — and to the evident needs of the college for all that is to be secured in the building.

Herbert Myrick, of Springfield, of the class of '82, spoke in behalf of the library committee of the alumni. Ex-President Stockbridge spoke of the progress and the aims of the college. Arthur A. Brigham, of the class of '78, and S. C. Damon, of the class of '82, also made pertinent addresses respecting the value and the prospects of the college. O. B. Hadwen, Esq., of Worcester, gave a detailed account of the plan of the building. Hon. C. L. Flint, of Boston, for a time president of the college, outlined its early history. The closing exercises were the singing of an original hymn by the audience, led by the college choir, prayer by the Rev. Samuel Snelling, rector of Grace Church in Amherst, the putting of the corner-stone in place by the presidents of the several classes now in college, and the benediction by the rector.

THE FARM.

John W. Clark, Farm Superintendent and Instructor in Agriculture, resigned April 1, to accept a position in a neighboring State. We cherish an esteem for him as a man, and shall remember his efforts to promote the welfare of the college. Since April 1, the President has been acting superintendent. Mr. David A. Wright has the farm in his immediate charge, and to his faithful work and direction the successful management of the farm is largely due. The work on the farm has been done in good season, and well done. In addition to the usual work for the season, the fitting and seeding of the thirty acres of pasture land has been completed. This land is our best pasturage — 25 acres have been seeded to mowing, and now promise a large yield of grass for another year. Most of the land to be planted next year is ploughed and some of it is manured.

The approximate list of crops harvested is as follows: 70 tons of hay, 740 bushels of shelled corn, 142 bushels of wheat and oats, 35 tons of beets, 500 bushels of carrots, 1,500 bushels of turnips, and 300 bushels of potatoes.

The results of good farming are two: increase of profitable crops, and improvement of the soil. The land of the college farm should be rendered more productive. Unless the New England farmer tills thoroughly and keeps his land in a highly productive condition, he cannot successfully compete, at present prices for labor, with the new lands of the West. To bring the tillage and mowing of the college farm to a high state of fertility will require large expense if done in one year, but it may be gradually accomplished by rotation of crops, and by saving carefully and applying skilfully fertilizing material.

So far as the farm is used for instruction it cannot be expected to yield pecuniary profit.

COURSE OF STUDY.

The general plan and object of the course of study were fully explained in our report of last year. From the four years' course at this college, Greek is excluded. Provision is made for the teaching of Latin one year. Thus a larger proportion of the four years than can be given in the regular course of the older colleges, is given to the study of the English language, the modern languages, and the natural sciences. In this college, as in the older colleges, the upper classes give due attention to those studies that lead one to a knowledge of himself and of his relations to his fellow-men and to God. Mental philosophy, political economy, history, civil polity, with special reference to our own government, and moral philosophy, are now an important part of the course. The act in accordance with which the college was founded, requires the "support and maintenance" of a "college where the leading object shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Hence in this college the sciences are to be taught in their relations to agriculture and in their applications to the mechanic arts. Military tactics, in accordance with the act founding the college, are also taught by a military officer, who is a graduate of West Point, and who, for the purpose of teaching, is detailed from the army of the United States. While the course thus tends to develop physical, intellectual and moral manhood, it has special relations to agriculture, furnishing special opportunities to those who wish to engage in horticulture, or in other departments of field work. There is no other institution in New England furnishing equal opportunities for practical instruction in the several departments of field and hot-house work.

A plain, substantial, but inexpensive building is needed for the agricultural department. This should be conveniently arranged for purposes of instruction, and with ample means of illustrating what is taught. There should be gathered under its roof a museum of agricultural implements and of agricultural products. Some of the graduates of the college are now making collections for such a museum.

While, as custodians of property belonging to the State, we feel bound to keep the buildings of the college in good condition as far as our funds will permit; and while we are aware that the new buildings and the improvements in other buildings must contribute to the efficiency of the college, we recognize clearly that buildings are but one means of success, and that a more important means are the appliances for teaching put into the buildings. Hence when the new building is completed and the class-rooms are permanently assigned to the several departments, we propose to provide additional means of instruction. There should be a considerable outlay for additional apparatus in the Department of Physics. The practical work of the college requires much objective teaching. Such teaching is impossible without suitable apparatus. Long ago there should have been at this college an agricultural library, superior to any other within the limits of the State. The value of such a library to the students of the college and to all who wish to investigate agricultural and related scientific subjects is evident, and we confidently expect that when our new library building is finished the donations of books and of money for the purchase of books will be largely increased.

ATTENDANCE.

Though there has been during the year a decided advance in the scholarship required to maintain one's standing in the several classes, the number of students in attendance at the College has not diminished. If one considers the intellectual power, the habits of study, and the character of the students now in the College, he must have no little satisfaction in its condition. When the present attendance is increased from 30 to 40 per cent. we shall have as many students as our present arrangements will justify. A greater number cannot be well accommodated, and if they could, a large increase of teaching force would be required, owing to the division of classes. Both economy and thorough instruction require that our numbers shall not exceed the limits indicated. At the beginning of the present college year thirty were admitted to the Freshman class. Twenty-six of these received scholarships, in accordance with the resolve passed by the legislature of 1883. The members of the Senate of our State have shown commendable faithfulness in giving notice in their several districts and in arranging for examination of candidates. The State College meets the wants of those who desire a more thorough scientific and practical training than can be obtained at most of our higher institutions. Such students are usually obliged to make their own way in the world, and are compelled to practice rigid economy. The expenses of the course though very moderate as compared with many other colleges, are beyond the means of a large proportion of those in whose interest the college was established. Whatever can be reasonably done to diminish the expenses of the course, the Trustees are disposed to do. Arrangements are made to employ students at such times as will not interfere with their studies, so far as circumstances will allow. With the co-operation of Mr. Wright, the farmer, and his wife, some of the students have formed a club and furnished themselves with good board for about $2.50 per week. I believe the State of Massachusetts, that in the past has done so much by direct gifts to other colleges and private institutions within the State to extend their usefulness, will not be slow to open the way to that increasing class of workingmen's sons who desire to avail themselves of the advantages of the State College, but who have not the means so to do.

IMMEDIATE NEEDS OF THE COLLEGE.

1. In the earlier part of this report we have noticed the condition of the Library and Chapel Building, and the course pursued by the Building Committee in its erection. An appropriation is now needed to put in heating apparatus, to furnish the library and reading-room, to provide cases for the State collections now in the care of the College, and to do what additional work may be necessary to complete the building according to its design.

2. The chemical laboratory building has been in almost

constant use for many years, both in term time and vacation. The floor of the laboratory is worn out, and other floors and walls require extensive repairs. The building in its interior needs a thorough renovating, and changes should be made that will better secure light and ventilation. It should be rendered more serviceable to the classes in chemistry. The appropriation for the erection of the Library and Chapel Building was made last year with the understanding that a part of the chemical laboratory building would be surrendered to the Experiment Station for its exclusive use as a laboratory. To make the changes needed, and to fit up this laboratory, it has been estimated that $2,000 will be sufficient, but there are reasonable doubts whether this amount will prove sufficient.

GIFTS.

At the time of the laying of the corner-stone of the Library and Chapel Building a letter was read by Prof. Goodell, received from J. C. Cutter of the Class of '72, now Professor of Physiology and Comparative Anatomy, Imperial College of Agriculture, Sapporo, Japan, announcing a gift of one hundred dollars in gold, to be expended in the purchase of recent scientific works for our library. C. S. Plumb, Assistant Director in the Experiment Station of New York, of the Class of '82, has sent us gifts of agricultural products for our museum. Books have been received from George Tolman, Esq., of Boston. We wish to express our thanks to the above named gentlemen, and to others who have aided us by gifts.

DEPARTMENT OF PRACTICAL AGRICULTURE.

President James C. Greenough.

Sir: — The following report on the course of instruction in Practical Agriculture for the year 1884 is respectfully submitted:

Twenty-two of the Freshmen of last year, twenty of the present Sophomores and all of the Juniors and Seniors have taken the course in agriculture. The general plan of instruction in this department, as given in outline in my report of last year, has been followed in the class-room, so that all of the classes in agriculture are now in their regular place in the course.

From the interest manifested by the students in the several topics presented, the course of instruction for the year has been, on the whole, satisfactory, notwithstanding the serious disadvantages arising from the want of suitable facilities for illustration.

During the past term the senior class have had a course of lectures on biology in its relations to agriculture, illustrated by work and experiments with culture apparatus and the microscope, performed by the students themselves, which has not only served to train them in exact methods of investigation, but enabled them to make actual demonstrations of the practical applications of the principles taught.

The rapid development of biological science within the past few years, and the many direct applications of the latest discoveries in almost every department of practical agriculture seem to indicate that the course of instruction may be profitably extended in this direction.

It has been said that "there is perhaps no department of science which so nearly concerns the wealth and well-being of the community," and it is safe to add that it is of paramount importance to the farmer from the fact that a large proportion of the problems of pecuniary interest, in the applications of science to practical agriculture, can only be solved by lines of inquiry in this newly developed science.

Satisfactory class work in this department can only be made with the aid of microscopes and other apparatus of the most perfect construction, and especially adapted to the purpose, and these are of course expensive.

An expenditure of from one thousand to fifteen hundred dollars can profitably be made, both in the interest of the students and the college, in providing the necessary apparatus for class instruction in this department.

In my report of last year, a suitable class-room, a work-room and an agricultural museum, were mentioned as among the most pressing wants of the department, and my experience in teaching the past year prompts me to give still greater emphasis to these defects in the means of instruction.

The present class-room for agriculture is the one not occupied at the time for other purposes, and I have given lectures in six different rooms within the year, without any opportunity for the use of diagrams or other essential means of illustration, as they would interfere with the legitimate use of the rooms by the department to which they were assigned.

If the Massachusetts Agricultural College is to occupy a leading position among the industrial colleges of the country, provision must be made to place agriculture on an equal footing, at least, with other departments in facilities for instruction and means of illustration.

MANLY MILES.

BOTANIC DEPARTMENT.

President J. C. Greenough.

Sir:—I have the honor to submit the following report as to the condition of the Botanic Department. The instruction in the class-room and the field in this department has been given in accordance with the college curriculum. The change in the course of study, bringing the subjects of botany and horticulture into the summer and fall, is a step in the right direction, making the work much more interesting and easier for both student and teacher.

The students have shown unusual interest in their work, which has been especially manifest in the very fine herbaria completed at the close of the fall term.

The work of instruction has been somewhat impeded by the efforts to have all the recitations in the rooms in the main college buildings. This is undoubtedly desirable for the economy of the students' time; but the best results in teaching the *natural sciences* can only be obtained where the recitation rooms are closely connected with cabinets and specimens for illustrations.

The crops during the season have been very abundant and of very fine quality, so much so that the prices received for them, in many cases, have been below the cost of production.

The trees in the peach and pear orchard received, during the winter of 1884, a severe "heading in," and are very much improved in form. The peach trees thus treated, many of them indicated signs of "yellows," but the effect of this pruning, and the application of an abundance of bone and potash, has apparently restored them to complete health. About five hundred young peach trees were planted in May on the slope east of the chestnut grove, and have made a very satisfactory growth.

Notwithstanding the very low prices of all garden produce, the income from the sales of the department is much larger than for the year of 1883.

FINANCIAL STATEMENT.

Dr.

To cash sales as follows:		
Received from sales of flowers,		$535 42
“ “ “ plants,		1,077 28
“ “ “ trees,		2,569 05
“ “ “ fruit,		615 71
“ “ “ vegetables,		1,113 03
“ “ “ sundries,		1,098 99
Total cash sales,		$7,009 48
To bills due at date,	$1,188 24	
“ increase in produce on hand,	90 00	
“ “ hay and grain,	100 00	
“ bills paid incurred previous to Jan. 1, 1884,	579 97	
		1,958 21
Total income,		$8,967 69

Cr.

By cash paid out by treasurer,	$7,804 73	
“ “ “ department,	28 84	
“ bills due Jan. 1, 1884,	350 65	
“ “ unpaid to date,	250 00	
		8,434 22
Balance,		$533 47

S. T. MAYNARD.

CHEMICAL DEPARTMENT.

President James C. Greenough.

Sir: — The course of instruction given during the past year, in the chemical department, has been in the main the same as the preceding year, with the exception that organic chemistry, with reference to its application in industry and agriculture, will be taught hereafter in the second senior term.

The Senior, Junior and Sophomore classes have taken part in the exercises. The Sophomore class has received instruction during two terms in the chemistry of non-metallic and metallic elements, with practical illustration of the best modes for their recognition. The Junior class has been engaged with practical chemical work in the laboratory, for two terms in succession. During the first term they have studied the characteristics of the common metallic elements, by ways of the blowpipe, and humid analysis. The second term has been occupied with learning the properties of the most important mineral acids and their principal combinations with metallic oxides.

The Senior class has devoted one term of laboratory work to the examination of prominent products of various branches of chemical industry, and of refuse material employed for manurial purposes, besides analyzing commercial fertilizers, soils and important minerals.

The composition and application of commercial fertilizers and of manurial matter in general, has been treated in this connection by a series of special lectures.

Aside from the regular class duties, considerable attention has been given to chemical work in the laboratory, by advanced students and post-graduates.

The general mode of instruction in the chemical department consists of lectures with experimental illustrations, followed by recitations. The students are obliged to write out the principal points of the lectures, and are marked on both recitations and notes. The laboratory work is accompanied by a suitable series of discourses on the best modes of analysis, and their proper application. A record of the practical work carried on has to be presented to the teacher at stated times.

The entire course in theoretical and practical chemistry has been arranged to meet the aim of the College, *i. e.*, to prepare young men for a successful employment in the various chemical industries, and in agriculture in particular.

During the last term of the past year Professor H. E. Stockbridge has entered with much success upon his duties as Assistant Professor in Chemistry. The instruction, during the first term of the Sophomore year, above referred to, has been given by him.

I am, very respectfully, yours,

C. A. GOESSMANN.

AMHERST, DEC. 24, 1884.

ANATOMY AND PHYSIOLOGY.

President JAMES C. GREENOUGH.

SIR: — I have the honor to submit the following report: —

In this department the endeavor has been to present the subjects under consideration, in as clear and practical a manner as possible, and to attempt to cover only as much ground as could be profitably covered in the limited time at our disposal.

My idea has been that instruction in anatomy and physiology appropriate for a College course should embrace a thoroughly practical discussion of these subjects, carried on by means of lectures, recitations, frequent illustrations, and practical exercises.

The course, therefore, so far as possible, has been made to conform to this idea. Instruction has been given, chiefly by lectures, in Descriptive Anatomy, so far as is necessary for an intelligent understanding of physiology. This subject has been taught by means of a text-book and lectures. In addition to the above, considerable time has been devoted to the study of Histology, or Microscopic Anatomy; and an effort was made, when considered practicable, to touch upon Physiological Chemistry. The study of the minute structure and composition of the various tissues and organs of the human body has often been neglected in College courses. Teaching is not only simplified, but is rendered far more interesting, by the frequent use of illustrations. For these reasons, skeletons, classic models, fresh specimens, diagrams and charts, and microscopic sections, have been in constant use.

The average scholarship, and the interest manifested by the class, were very satisfactory.

The most urgent need of the department at present, is a set of standard works, for reference on the various subjects taught. This want has been met in part by the generous gift of Prof. John C. Cutter, of the Imperial College of Agriculture, Sapporo, Japan.

During the past term anthropometric observations were made, by Prof. Manly Miles and myself, upon over fifty students of the college, and as a result, nearly three thousand measurements were recorded. These statistics were taken partly with a view to their bearing upon the much-disputed question of Bilateral Asymmetry of Function. It was hoped that these statistics would be ready for publication in the present College report, but from unavoidable causes it was impossible to prepare them in time.

FREDERICK TUCKERMAN.

MATHEMATICAL DEPARTMENT.

President James C. Greenough.

Sir: — I have the honor to submit the following brief report of the department of mathematics and physics.

The instruction in this department was placed in my charge at the beginning of the present college year. I found a manifest interest in college duties existing among the students, and thus far the work in every respect has progressed quite satisfactorily. But the success and rapid progress of the higher classes are largely due to the careful preparation and efficient labor of my predecessor, Professor Bassett. The method of instruction is similar to that adopted by higher institutions of learning; viz., the text-book, supplemented by lectures. All fundamental principles are demonstrated before the class. This method saves much time, and affords the student a better opportunity for comprehending the matter under discussion, and learning the manipulation of difficult formulæ.

Much inconvenience, however, is felt in not having suitable apparatus to insure complete success. Mechanics, electricity and civil engineering are well supplied; but apparatus for illustrating the principles of sound, heat and light are wholly deficient. It seems proper to call the attention of the honorable Board of Trustees to this matter, and to recommend that, as soon as they deem it advisable, sufficient means be appropriated to make the lecture-room more convenient, and place the physical cabinet in a suitable and more respectable condition. As mathematics occupies a prominent place in the curriculum, a higher standard for admission must be apparent to all. One, or perhaps two, books of geometry cannot be of detriment to the student, but will, on the contrary, result in a more advanced college course.

It is earnestly hoped that the several recommendations herein contained will meet the favorable consideration of the honorable Board.

Respectfully submitted.

C. D. WARNER.

MILITARY DEPARTMENT.

James C. Greenough,
President of the Massachusetts Agricultural College.

Sir: — During the present year the work in this department has followed the plan laid down in the last annual report, with but slight changes. The discipline of the corps has been transferred somewhat more than formerly to the first class officers, and thus far with encouraging results. The system adopted of placing certain divisions of the dormitories under the control of the officers, and of holding them responsible for their good order and quiet during study hours, is likely to develop satisfactorily. At no time since my coming has the interest been greater, or the result of the instruction more apparent. It seems proper that I should again urge that some plan be adopted which will enable the corps to go into camp at Framingham for two weeks, yearly, after the close of the summer term. There are no facilities here for giving practical instruction to the cadets in the duties of sentinels and general camp work. It is fundamental for the educated soldier, and none who appreciate the wisdom of having a full supply of capable company and field officers in case of need, could dissent from such legislation as will incorporate this suggestion into the State militia laws. Hereto is appended the theoretical and practical course of the military department, with the names and grades of those holding official positions in the present battalion organization.

I have the honor to be, your respectful servant,

VICTOR H. BRIDGMAN,
First Lieutenant 2d U. S Artillery.

THEORETICAL AND PRACTICAL COURSE OF INSTRUCTION.

THEORY.

Fall term, Freshman year. One hour per week for the term. Recitations in infantry tactics (Upton's). School of the Soldier. School of the Company. Skirmish drill.

Fall term, Sophomore year. One hour per week for the term. Recitations in U. S. Artillery tactics. School of the Soldier (dismounted), sabre exercise, manual of the piece and mechanical manœuvres, bayonet exercise (infantry tactics). Ammunition, equipment of carriages. Modified service of 8-inch mortars.

Fall term, Junior year. Recitations in infantry tactics (Upton's). One hour per week for the term. School of the battalion. Ceremonies. Company and field service.

MILITARY SCIENCE.

This instruction is given to seniors, extending through the entire college year, two hours per week.

It will include, in the form of lectures and recitations from selected text-books, the following subjects: Ordnance and gunnery; constitutional and military law and history; campaigns and battles; systems of warfare, present and past; an elementary course in strategy and engineering. It will be modified by such additions and changes as shall seem desirable. Essays are required from each senior on military subjects, when they have become sufficiently instructed to prepare them advantageously. These papers will be read in the recitation room for general note and criticism, or before the entire college. One set, all upon the same subject, are written for prizes, — the award being made by a board of army officers. The successful competitors read their productions at the graduating exercises.

PRACTICE.

All students, unless disqualified physically, are required to attend prescribed military exercises, those who pursue special or partial courses at the college not being exempt so long as they remain at the institution. By the commencement of their second term, students are required to provide themselves with a full uniform, comprising coat, blouse, trousers, cap, white gloves, etc., all of which costs about $30. Correctness of deportment and discipline are required of all, the routine of the West Point Academy being followed as closely as circumstances will permit. To insure a proper sanitary condition of the college, the commandant makes careful inspections of all rooms and college buildings each Saturday morning, during which all students in full uniform are required to be in their rooms, for the proper police of which they are held to a strict accountability.

At the beginning of each term, issues of such equipments as they will require are made to all students. They will be charged for all injury, loss, and for any neglect in the care of the same.

For practical instruction, the following public property is in the hands of the college authorities : —

One platoon of light Napoleons (dismounted).
One six-pounder with limber and equipments.
Seventy-five sabres and belts.
One hundred breech-loading rifles (latest model).
Several accurate target rifles.
Two 8-inch siege mortars, with complete equipments.

For practice firing, the United States furnishes blank cartridges for all guns, and ball cartridges for rifle practice, which is encouraged by the department.

Drills, amounting to rather less than four hours per week, are as follows : —

Infantry : schools of the soldier, company, and battalion ;

manual of arms and sword; bayonet exercise, skirmish drill, target practice; ceremonies, marches, field service.

Artillery: schools of the soldier, detachment, and battery (dismounted). Mortar drill, sabre exercise, pointing, and field service.

BATTALION ORGANIZATION.

For instruction in infantry tactics and discipline, the cadets are organized into a battalion of two or more companies under the commandant. The officers, commissioned and non-commissioned, are selected from those cadets who are best instructed and most soldier-like in the discharge of their duties. As a rule, the commissioned officers are taken from the seniors, the sergeants from the juniors, and the corporals from the sophomores. All seniors are detailed to act as commissioned officers.

Commissioned Staff.

George H. Barber, *First Lieutenant and Adjutant.* Charles S. Phelps, *First Lieutenant and Quartermaster.*

Non-commissioned Staff.

George W. Wheeler, *Sergeant-Major.* David F. Carpenter, *Quartermaster Sergeant.*

Color Guard.

Sergeants, — Kingsbury Sanborn, *National Colors.* Richard F. Duncan, *State Colors.*

Privates, — C. S. Howe, F. B. Carpenter, W. H. Caldwell, W. M. Ball, S. H. Long, F. C. Allen.

Captains.

1. Joel E. Goldthwait, Co. A. 2. Edwin W. Allen, Co. B. 3. Edward R. Flint, Co. C.

Lieutenants.

1. Hezekiah Howell, Co. A. 2. Charles W. Browne, Co. B. 3. L. J. de Almeida, Co. C.

First Sergeants.

1. Charles W. Clapp, Co. A. 2. Winfield Ayre, Co. B. 3. John K. Barker, Co. C.

Sergeants.

1. Kingsbury Sanborn, Co. B.
2. Richard F. Duncan, Co. C.
3. George S. Stone, Co. A.
4. R. B. Mackintosh, Co. B.
5. Chas. F. W. Felt, Co. C.
6. William H. Atkins, Co. A.

Corporals.

1. Herbert J. White, Co. A.
2. James M. Marsh, Co. B.
3. John J. Shaughnessy, Co. C.
4. Fred. H. Fowler, Co. A.
5. Richard H. Bond, Co. B.
6. C. W. Fisherdick, Co. C.
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8. Jer. C. Osterhout, Co. B.
9. Edward W. Barrett, Co. C.
10. Joseph S. Martin, Co. A.
11. Augusto L. de Almeida, Co. B.
12. H. N. W. Rideout, Co. C.

CALENDAR FOR 1885.

January 7, Wednesday, winter term begins, at 8.15 A.M.
March 27, Friday, winter term closes, at 10.30 A.M.
April 6, Tuesday, summer term begins, at 8.15 A.M.
June 21, Sunday,
- Baccalaureate sermon.
- Address before the Christian Union.

June 22, Monday,
- Grinnell Prize Examination of senior class in Agriculture.
- Farnsworth Prize Speaking.

June 23, Tuesday,
- Meeting of the Alumni.
- Military Exercises.
- Commencement Exercises.
- Alumni Dinner.
- President's Reception.

June 24, Wednesday, Examination for admission.
September 8, Tuesday, Examination for admission.
September 9, Wednesday, fall term begins, at 8.15 A.M.
December 18, Friday, fall term closes, at 10.30 A.M.

1886.

January 6, Wednesday, winter term begins, at 8.15 A.M.
March 26, Friday, winter term closes, at 10.30 A.M.

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Professor of Chemistry.

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Professor of Botany and Horticulture.

MANLY MILES, M. D.,
Professor of Agriculture.

CLARENCE D. WARNER, B. S.,
Professor of Mathematics and Physics.

HORACE E. STOCKBRIDGE, Ph. D.,
Assistant Professor of Chemistry.

——— ———

Professor of Comparative Anatomy and Veterinary Science.

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Professor of Military Science and Tactics.

JOHN F. WINCHESTER, D. V. S.,
Lecturer on Veterinary Science and Practice.

ROBERT W. LYMAN, Esq.,
Lecturer on Rural Law.

FREDERICK TUCKERMAN, M. D.,
Lecturer on Anatomy and Physiology.

COURSE OF STUDY AND TRAINING.

Freshman Year.

Fall Term.

ALGEBRA — Wells's University Algebra.

BOTANY. — Structural Botany and the study of the functions of vegetable organisms.

FRENCH. — Principles and applications of grammar, pronunciation, oral and written exercises in translating from French into English and from English into French. Keetel's French Grammar. Readings from French authors.

HISTORY. — Ancient Greece and Rome, with reference to modern institutions. Modes of life and institutions of the Middle Ages, with reference to the evolution of our political and other institutions.

Winter Term.

PLANE GEOMETRY AND THEORY OF EQUATIONS. — Wentworth's Geometry

MICROSCOPY. — The study and the use of the Microscope. The Microscope, by Carpenter.

FREE-HAND DRAWING. — White's Series. Object Drawing and Original work.

FRENCH. — Translations, oral and written, from French into English.

HISTORY. — Beginnings of Modern History. Period of the Protestant Revolution. Thirty Years' War. Development of the nationalities of Western Europe. Progress of civil freedom.

Summer Term.

SOLID GEOMETRY. — Wentworth's Geometry.

BOTANY. — Analysis. Systems of classification. Practical exercises in classification and in collecting and arranging herbaria. Bessey's Botany. Gray's Manual.

FRENCH. — Translation of some scientific or historic work, as Puydt Les Plantes de Sewe.

AGRICULTURE. — History of Domestic Animals. Characteristics and development of different breeds, illustrated by stereopticon views of typical forms.

Freshmen who do not study "History" and "Agriculture," elect French.

Sophomore Year.

Fall Term.

Conic Sections and Plane Trigonometry. — Griffin's Conic Sections. Wells's Trigonometry.

Botany. — Systematic Botany. Special study of useful and common plants. Bessey's Botany. How plants grow, by Johnson.

Chemistry. — Elementary Inorganic Chemistry. Instruction given by lectures and text-book, and all important facts experimentally demonstrated. Introduction to the study of Chemistry. Nomenclature. Symbols. Atomic Weights. Water and its constituents. Air and its constituents. Quantivolence. Radicals. Stoichiometry. Acids. Bases. Salts. Consecutive consideration of the non-metallic elements.

German. — Sheldon's Grammar. Boisen's Reader. Oral and written exercises.

Agriculture. — Stock breeding; laws of heredity; causes of variation; in-and-in breeding and cross-breeding; form of animals as an index of qualities; selection and care of animals; feeding for meat production; the dairy and its work.

Winter Term.

Spherical Trigonometry and Mensuration.— Measurement of lines, angles, surfaces, solids and volumes. Wells's Trigonometry. Todhunter's Mensuration.

Chemistry. — Metals of the alkalies. Metals of the alkaline earths. Metals of each succeeding group considered distinctively. Each element and subject is first treated from a theoretical standpoint, and then the agricultural and technical significance of the facts learned are considered.

Anatomy and Physiology. — Descriptive Anatomy by means of skeletons, classic models, fresh specimens, dissection, diagrams and charts. Lectures and discussion of topics. Microscopic anatomy. Chemical analysis.

Mechanical Drawing. — White's Series. Use of instruments. Building plans, specifications, etc.

German. — Eichendorff. Aus dem Leben eines Taugenichts. Oral and written exercises.

Agriculture. — History of Agriculture, with particular reference to the development of systems and rules of practice. Pioneer farming, its methods and results. Mixed husbandry, — general principles and their special applications; cereals, forage crops, pastures and meadows. Drainage, general principles; different kinds of drains; laying out and construction of drains; improved methods of laying tiles.

Summer Term.

CIVIL ENGINEERING. — Practical work with instruments in measuring heights and distances. Plane and topographical surveying, levelling, construction of railroad curves, embankments and excavations, drainage, etc.

ZOOLOGY. — Introductory lessons by means of specimens. Systems of classification. The analytic study of typical forms of animal life.

GERMAN. — Rau. Die Grundlage der Modernen Chemie. Oral and written exercises.

HORTICULTURE. — Cultivation and propagation of fruits. Lectures, with oral and written abstracts.

Sophomores who do not study "Agriculture" and "Horticulture," elect German.

Junior Year.

Fall Term.

MECHANICS. — Lectures. Oral and written abstracts. Dana's Mechanics.

ENGLISH LITERATURE. — Lectures on the early history of the English Nation and formation of the language. Study of the early literature.

GEOLOGY. — Instruction given by lectures, by text-books, and by constant field work in the study of rocks and geological formations, with particular reference to the recognition of the characteristics of the different periods of geological history, and the application of the facts gained, to agriculture, as related to the formation, composition and characteristics of soils.

LATIN.

HORTICULTURE. — Market gardening and floriculture. Entomology, with special reference to injurious and beneficial insects. Packard's Guide to Study of Insects.

Winter Term.

PHYSICS AND ANALYTICAL GEOMETRY. — Atkinson's Ganot's Physics, new edition. Loomis's Analytical Geometry.

ENGLISH LITERATURE. — Study of Shakespeare. Lectures on the historic epochs in connection with the text-book. Original theses.

CHEMISTRY. — Instruction in the laboratory, with recitations. Blowpipe analysis, with the determination of the characteristics of the more common metals and minerals. Determination of unknown substances. Humid analysis. Determination of characteristics of all the commonly occurring elements. Determination of bases and acids in known compounds.

LATIN.

AGRICULTURE. — Soils; farm implements; manures; rotation of crops.

Summer Term.

Physics and Differential Calculus.

Chemistry. — Determination of qualitative composition of unknown substances Analysis of fertilizers, of soils, and of agricultural and technical raw products.

Chemical Geology. — Instruction by lectures. Formation of rocks, geological stages or periods with the characteristic formations of each period, and the phenomena accompanying each change Chemical composition of the rocks forming the earth's crust, with a review of the minerals constituting these rocks. Chemical changes by which the rocks have been converted into an arable soil. The chemical characteristics of the resulting soil as related to the production of plants.

Latin.

Horticulture. — Forestry and landscape gardening. Methods of propagation and cultivation of forest trees. Study of trees and plants most desirable for land decoration, with principles and rules of arrangement. Lectures, with oral and written abstracts. Hough's Elements of Forestry.

Juniors who do not study "Agriculture" and "Horticulture," elect Latin.

Senior Year.

Fall Term.

Physics and Integral Calculus. — Loomis's Differential and Integral Calculus.

Chemistry. — Analysis of prominent products of chemical industry. Special lectures upon the same.

Mental Science. — Outline by inductive teaching, and by lectures. Study of topics aided by Porter, Cousin, Hamilton, etc. Oral recitations by topics and written abstracts. History of philosophy. Lectures.

Winter Term.

Chemistry. — Organic chemistry with reference to applications in agriculture and other industries.

Political Economy. — Treatment of the subject by lectures, discussions and abstracts. Laughlin's Mill's Political Economy. Perry's Political Economy.

Biology. — The study of forms of life, their structure and functions. Laboratory practice and experiments. Biology in its relations to agriculture.

Astronomy.

Summer Term.

ANTHROPOLOGY.

MORAL SCIENCE. — Outline of principles by inductive teaching and by lectures. Discussions. Recitations by topics and by abstracts Philosophic Basis of Theism, by Harris. Hopkin's Law of Love.

HISTORY OF MODERN PHILOSOPHY. — Lectures.

VETERINARY SCIENCE. — Lectures.

RURAL LAW. — Lectures.

CONSTITUTIONAL HISTORY. — Origin and development of the English Constitution. Colonial governments. Government of the United States. History of political parties. Development of popular governments in Europe during the present century.

METEOROLOGY.

The studies of the Senior Year are in good degree class electives.

In all studies, students are to be trained to accurate and ready oral and written expression, and to use drawing as language. Military tactics and military drill, as ordered, throughout the course. Weekly exercises in compositions and declamations throughout the course. The instruction in agriculture and horticulture is both theoretical and practical. Instruction in the field and manual training is given whenever such instruction and training will conduce to the progress of the student. Students are allowed to work for wages during such leisure hours as are at their command. A limited amount of work has been found to be beneficial, but work that withdraws the energy of the student from his studies is unprofitable to him. Students sometimes earn from fifty to one hundred dollars per annum. Those who complete the course receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the college may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the college, thereby becoming entitled to all the privileges of the alumni.

ADMISSION.

Candidates for admission to the Freshman Class are examined orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, the history of the United States, and the Metric System.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the college until he is fifteen years of age. Every applicant is required to furnish a certificate of good character from his late pastor or teacher. Candidates are requested to furnish the Examining Committee with their standing in the schools they have last attended. The previous rank of the candidate will be considered in admitting him.

EXPENSES.

Tuition in advance.			
Fall term,	$30 00		
Spring term,	25 00		
Summer term,	25 00	$80 00	$80 00
Room rent, in advance, $5.00 to $10.00 per term,		15 00	30 00
Board, $3.50 to $5.00 per week,*		133 00	190 00
Washing, 30 to 50 cents per week,		11 40	19 00
Fuel, $5.00 to $15.00 per year,		5 00	15 00
Expense per year,		$244 40	$334 00

To the above must be added thirty dollars to obtain a military suit, which is to be obtained during the first term of attendance at college, and is to be used in drill exercises during the four years' course. Those who use the laboratory for practical chemistry will be charged ten dollars per term. Some expense will also be incurred for lights and for text-books. Students whose homes are within the State of Massachusetts can, in most cases, obtain a scholarship by applying to the senator of the district in which they live. The outlay of money can be further reduced by work during leisure hours on the farm or in the botanic department. The opportunities for such work are more abundant during the Fall and Winter terms.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given: In the south dormitory the main corner rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

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* Several students, during most of the year, have formed a club and furnished themselves with board for about two dollars and fifty cents per week.

THE ROBINSON SCHOLARSHIP.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

CONGRESSIONAL SCHOLARSHIPS.

The trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution, and should enter college with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture.

STATE SCHOLARSHIPS.

The legislature of 1883 passed the following Resolve in favor of the Massachusetts Agricultural College: —

Resolved, That there shall be paid annually, for the term of four years from the treasury of the Commonwealth to the treasurer of the Massachusetts Agricultural College, the sum of ten thousand dollars, to enable the trustees of said college to provide for the students of said institution, the theoretical and practical education required by its charter and the law of the United States relating thereto.

Resolved, That annually for the term of four years, eighty free scholarships be and hereby are established at the Massachusetts Agricultural

College, the same to be given by appointment to persons in this Commonwealth, after a competitive examination, under rules prescribed by the president of the college, at such time and place, as the senator then in office from each district shall designate; and the said scholarships shall be assigned equally to each senatorial district; but if there shall be less than two successful applicants for scholarships from any senatorial district, such scholarships may be distributed by the president of the college equally among the other districts, as nearly as possible, but no applicant shall be entitled to a scholarship unless he shall pass an examination in accordance with the rules to be established as herein before provided.

In accordance with these resolves, any one desiring admission to the college can apply to the senator of his district for a scholarship.

PRIZES.

Farnsworth Rhetorical Prizes.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, the income of which is to be used as prizes, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

Grinnell Agricultural Prizes.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of forty dollars, and a second prize of twenty-five dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

Hill's Botanical Prizes.

For the best herbarium collected by a member of the class of 1885, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The **Library** of the College contains at present about three thousand volumes. The income of the fund raised by the alumni and others is devoted to its increase, and additions are made from time to time, as the needs of the several departments require.

The **State Cabinet** of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction. It has recently received valuable additions of several thousand specimens of minerals, fossils, shells, insects and birds' eggs and nests.

The **Knowlton Herbarium** contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About **Fifteen Hundred Species and Varieties of Plants** are cultivated in the Durfee Plant House, affording the student an invaluable opportunity of studying the most important types of the vegetable kingdom in their scientific and economic relations.

The **Class in Microscopy** has the use of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the Faculty in their respective departments.

PHYSICAL CULTURE.

The military exercises in the open air, or in a spacious hall provided for the purpose, tend to promote health, erect form, and prompt, effective and graceful movement.

RELIGIOUS SERVICES.

Chapel exercises every morning at a quarter after eight o'clock. On Sundays the students attend morning service in the chapel, unless, by request of their parents, arrangements are made to attend church elsewhere. On Sabbath afternoons, or immediately following the morning service, there is opportunity for every student to study the Bible in a Bible class.

The Young Men's Christian Association holds weekly meetings. The Sabbath evening services in churches about one mile distant, and meetings conducted by the students, furnish additional opportunities for religious culture.

CONDUCT.

Students are expected to co-operate with their instructors and with each other in promoting the welfare of the college, in order that every student may receive the best possible results of the course of study and training. Whenever it is evident that it is not for the good of a student to remain in the college, or that the welfare of the college requires that he should not remain, he will be dismissed.

LOCATION.

Amherst is on the New London & Northern R.R., connecting at Palmer with the Boston & Albany R.R., and at Miller's Falls with the Fitchburg R.R. A stage route of seven miles connects Amherst at Northampton with the Connecticut River R.R., and with the New Haven & Northampton R.R. The college buildings are on a healthful site commanding one of the finest views in New England. The large farm of three hundred and eighty-three acres, with its varied surface and native forests, gives the student the freedom and the quiet of a country home. The surrounding country is very helpful to the student of natural science. The location of the buildings prevents the student from the interruptions to study incident on residence in a town or city, and helps to secure all the moral as well as the intellectual advantages of a college in the country.

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